A GUIDE

TO THE

EXHIBITION GALLERIES

OF THE DEPARTMENT OF

GEOLOGY AND PALÆONTOLOGY

IN THE

BRITISH MUSEUM (NATURAL HISTORY),

CROMWELL ROAD, LONDON, S.W.

PART II.
FOSSIL REPTILES, FISHES, AND INVERTEBRATES.

WITH 94 ILLUSTRATIONS AND 1 PLAN.

PRINTED BY ORDER OF THE TRUSTEES.

1890.

PRICE SIXPENCE.

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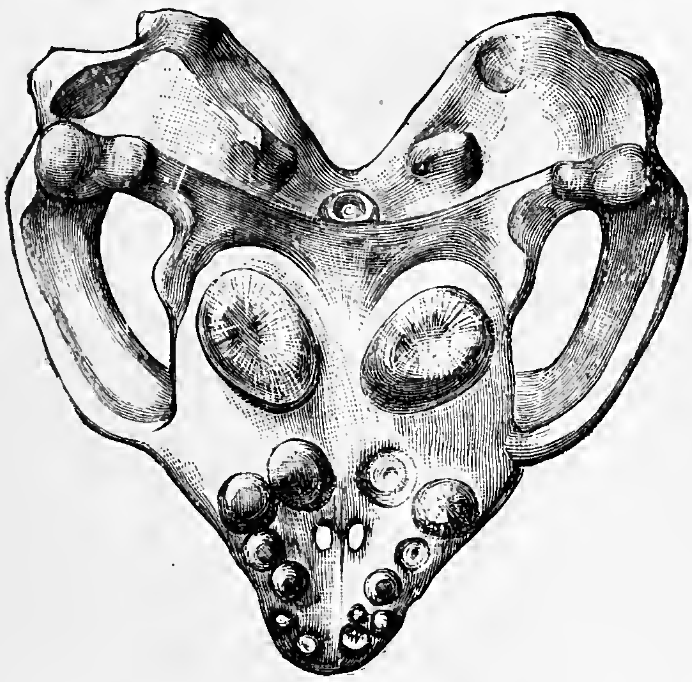

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(PART II.)

INVERTEBRATA.

Sub-Kingdom.—MOLLUSCA.

Division A.—MOLLUSCA (proper).

* This includes also the Stegosauria (or plated lizards).

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PREFACE.

The First Edition of this Guide was issued, without illustrations, on the 19th April, 1881; the second in 1882, illustrated with thirty-one wood engravings; a third, slightly altered, appeared in 1884. A fourth Edition, almost wholly re-written, with many fresh illustrations, appeared in 1886, and a fifth, with only a few alterations, in 1888. Of these five editions, altogether 15,000 copies have been issued.

The publication of Mr. R. Lydekker's Museum Catalogues of the "Fossil Mammalia," Parts I–V. (1885–87), and the "Reptilia and Amphibia," Parts I–IV. (1888–90), has compelled the re-arrangement of a great part of these Collections, and also changed the plan of the Guide. Much additional information is given in this Edition, and the illustrations have been increased from forty-nine to two hundred and eleven. It has therefore been found necessary to subdivide it into two parts, each of which is larger than the former Guide.

The writer is largely indebted to the authors of Nicholson's and Lydekker's "Palæontology" (Vol. II., "Vertebrata," by R. Lydekker), from which numerous notes and extracts have been made in the compilation of this Guide, as well as to Mr. Lydekker, for much personal help. The Director, Professor Flower, has kindly read the sheets and made valuable suggestions and emendations. The Members of the Staff of the Department have also obligingly assisted in the work.

HENRY WOODWARD.

Department of Geology,

10th April, 1890.

TABLE OF STRATIFIED ROCKS.

Periods.		SYSTEMS.	FORMATIONS.	LIFE-PERIODS.
CAINOZOIC.	Quaternary.	**RECENT**	Terrestrial, Alluvial, Estuarine, and Marine Beds of Historic, Iron, Bronze, and Neolithic Ages	Dominant type, Man.
		PLEISTOCENE (250 ft.)	Peat, Alluvium, Loess Valley Gravels, Brickearths Cave-deposits Raised Beaches Palæolithic Age Boulder Clay and Gravels	
	Tertiary.	**PLIOCENE** (100 ft.)	Norfolk Forest-bed Series Norwich and Red Crags Coralline Crag (Diestian)	Dominant types, Birds and Mammals.
		MIOCENE (125 ft.)	Œningen Beds Freshwater, &c.	
		EOCENE (2,600 ft.)	Fluvio-marine Series (Oligocene) Bagshot Beds, London Tertiaries } (Nummulitic Beds)	
SECONDARY OR MESOZOIC.		**CRETACEOUS** (7,000 ft.)	Maestricht Beds Chalk Upper Greensand Gault	
		NEOCOMIAN	Lower Greensand Wealden	
		JURASSIC (3,000 ft.)	Purbeck Beds Portland Beds Kimmeridge Clay (Solenhofen Beds) Corallian Beds Oxford Clay Great Oolite Series Inferior Oolite Series Lias	Dominant type, Reptilia.
		TRIASSIC (3,000 ft.)	Rhætic Beds Keuper Muschelkalk Bunter	
PRIMARY OR PALÆOZOIC.		**PERMIAN or DYAS** (500 to 3,000 ft.)	Red Sandstone, Marl, Magnesian Limestone, &c. } Zechstein Red Sandstone and Conglomerate Rothliegende	Dominant type, Fishes.
		CARBONIFEROUS (12,000 ft.)	Coal Measures and Millstone Grit Carboniferous Limestone Series	
		DEVONIAN & OLD RED SANDSTONE (5,000 to 10,000 ft.)	Upper Old Red Sandstone Devonian Lower Old Red Sandstone	
		SILURIAN (3,000 to 5,000 ft.)	Ludlow Series Wenlock Series Llandovery Series May Hill Series	
		ORDOVICIAN (5,000 to 8,000 ft.)	Bala and Caradoc Series Llandeilo Series Llanvirn Series Arenig and Skiddaw Series	Dominant type, Invertebrata.
		CAMBRIAN (20,000 to 30,000 ft.)	Tremadoc Slates Lingula Flags Menevian Series Harlech and Longmynd Series	
		EOZOIC—ARCHÆAN (30,000 ft.)	Pebidian, Arvonian, and Dimetian Huronian and Laurentian	

Range of Invertebrata and Plants in time

Range of Fishes in time.

Range of Reptilia in time.

Footprints of Birds ?—Range of Birds in time

Range of Mammalia in time.

DEPARTMENT OF

GEOLOGY AND PALÆONTOLOGY.

INTRODUCTION.

NEARLY every city has within its bounds some relics of earlier times, when a more ancient people occupied the same spot.

Thus below modern London we find various layers of accumulated soil, each marked by tokens of former times. In one we find the charred relics of the wooden buildings which preceded the more modern brick and stone houses; beneath this are found weapons, coins, and pottery, telling of Norman and Saxon times. More than 20 feet down we come upon the relic-bed of Roman London, and in some parts *two* Roman *periods* have been recognised with remains of buildings at different depths. At a still lower level, along the course of the ancient Wall-brook, remnants of pile-dwellings have been discovered, which were probably occupied by an earlier British race.

In the ancient gravels of the Thames Valley, both beneath and around London, stone implements, left by a yet earlier people, have been frequently met with, associated with bones and teeth of the Mammoth.

If in a similar manner we investigate those larger layers of Chalk and Limestone, Sandstone, Clay, or Slate, composing the Earth's crust, we not only find that they rest upon one another, so that we can judge of their relative age by the order of their superposition, but that, like the layers of soil below London, they are often full of relics which tell of the former inhabitants that lived, flourished, and died out, to be succeeded by another race which have in their turn shared the same fate.

Geology deals with the Earth, the composition of the various strata, or layers, of which it consists, their present and former extent, and the physical conditions under which they were deposited, and the changes they have since undergone.

Palæontology deals with the remains of ancient life found in the various layers, and strives, by comparison with living forms, to restore the successive faunas and floras which have passed away, and to trace by those relics their past distribution, and thus to show the evolution of life on the earth from the earliest times to our own.

So many good books on Geology and Palæontology have been published * that it is not necessary to give in such a guide-book as the present a treatise on the science, but merely to explain that the Vertebrata in the Galleries are arranged according to their zoological classes, orders, and families (so far as these can be ascertained); and upon the label to each is placed its name, its geological position, and the locality whence it was derived. In the Invertebrata and Plants each class is also grouped chronologically in order, from the latest deposits to the earliest in which it occurs.

Whenever a specimen has been figured and described in a scientific work, a green disk is affixed to it, and a reference is given to the author, and to the name and date of the work where it was published.

Explanatory labels and illustrations have been introduced in many instances, to afford fuller information to visitors respecting the objects exhibited.

The plan, facing p. 102, will serve to show the general arrangement of the cases and their contents. The small Table of Strata, on p. x, is given to indicate the range in time of the great groups of Mammals, Birds, Reptiles, Fishes, Invertebrates, and Plants.

H. W.

* *See* specially "Manual of Palæontology," by Prof. H. Alleyne Nicholson and R. Lydekker, in 2 vols. (3rd Edition). Wm. Blackwood and Sons, Edinburgh and London. 1889.

GUIDE TO THE DEPARTMENT

OF

GEOLOGY AND PALÆONTOLOGY.

PART II.

REPTILIAN GALLERY.*

THIS Gallery is devoted to the exhibition of the remains of fossil Reptilia, a class which includes the Tortoises and Turtles, Snakes, Lizards, Crocodiles, and a large number of extinct forms, the exact zoological position of many of which we can only judge by analogy. Like the Mammalia, the Reptilian class lived both on land and in the water; some being evidently fitted for terrestrial locomotion by their well-developed legs; others, as shown by their paddle-shaped limb-bones, must have passed their entire existence in the water. One group, now extinct, possessed, like the Bats and the Birds, the power of flight. **Reptilian Gallery. Wall-case, No. 1.**

CLASS 3.—REPTILIA.

Order I.—PTEROSAURIA (WINGED-LIZARDS).

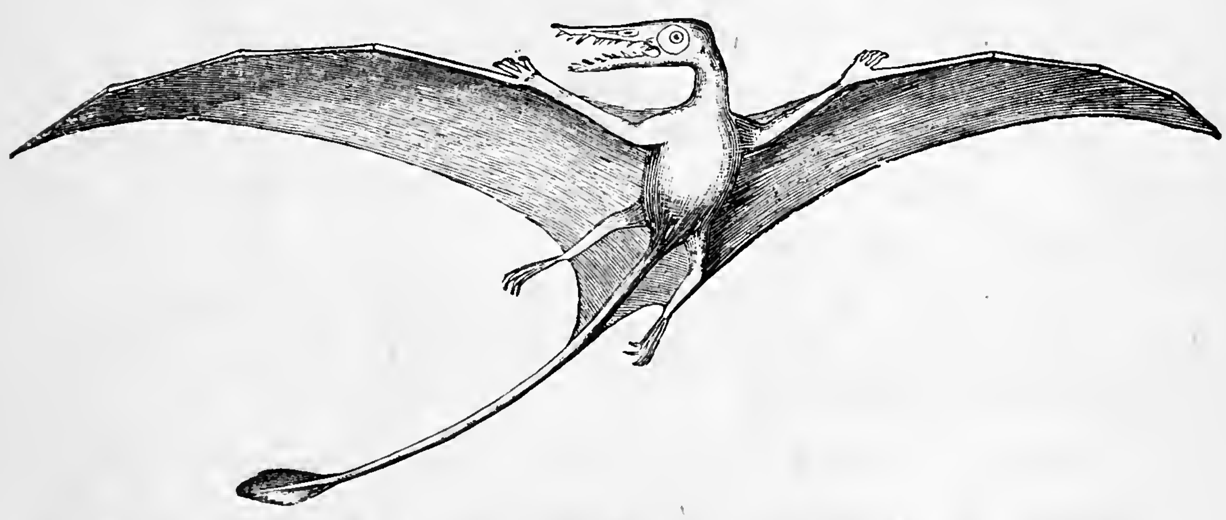


FIG. 1.—Restoration of *Rhamphorhynchus Muensteri*, Goldfuss (after Marsh); one-seventh natural size, from the Lithographic Stone, Eichstädt, Bavaria.

In Wall-case No. 1, and in Table-cases Nos. 1 and 2, are placed the fossil remains of this extinct group of "Flying Lizards," or Pterodactyles. These animals had the centra of the vertebræ hollow in front; they possessed a broad *sternum* or "breast-bone," with a median ridge or keel, similar to that of birds; the jaws were usually armed with teeth fixed in sockets. The fore-limb had a short humerus, a long radius and ulna, and **Pterodactyles. Wall-case, No. 1, Table-cases, Ncs. 1 and 2.**

* Galleries 3, 4, and 5 on Plan facing p. 102.

Flying Lizards.

one of the fingers of the hand was enormously elongated to give support to the wing-membrane (*patagium*), which was attached to the sides of the body, the arm, and the long finger, and also to the hind-limb and tail. The other fingers of the hand were free and furnished with claws. The wing-membrane appears to have resembled that of the Bat, being destitute of feathers. The caudal series of vertebræ in some genera (as in *Rhamphorhynchus*) was greatly elongated and stiffened with slender

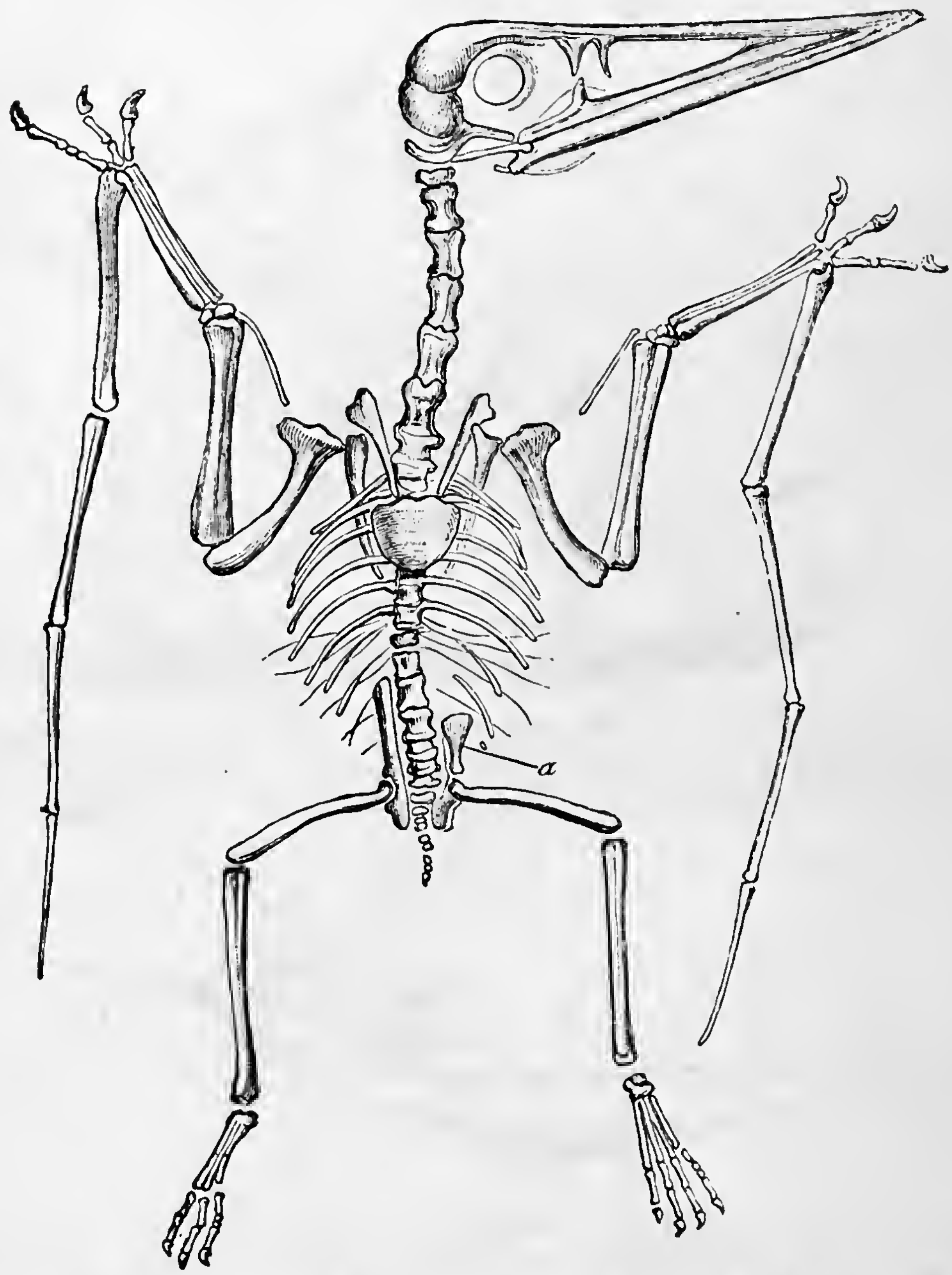


FIG. 2.—The nearly entire skeleton of *Pterodactylus spectabilis* (Meyer), from the Lithographic Stone, Upper Jurassic, Eichstadt, Bavaria. *a* is the pubis; on the right side the ilium is exposed (figured nat. size).

Wall-case, No. 1.

ossified fibres (Figs. 1 and 5). The bones were pneumatic (*i.e.*, filled with large air-cavities), the walls of the bones being very thin, and their substance very hard and compact, thus combining strength with lightness.

Numerous remains of nearly perfect Pterodactyles, with both long and short tails, and varying greatly in size, have been

obtained from the Solenhofen Limestone in Bavaria—others occur in the Great Oolite at Stonesfield, near Oxford; and in the Lias formation, Lyme Regis, Dorset. The most remarkable

Pterodactyles.
Wall-case, No. 1.

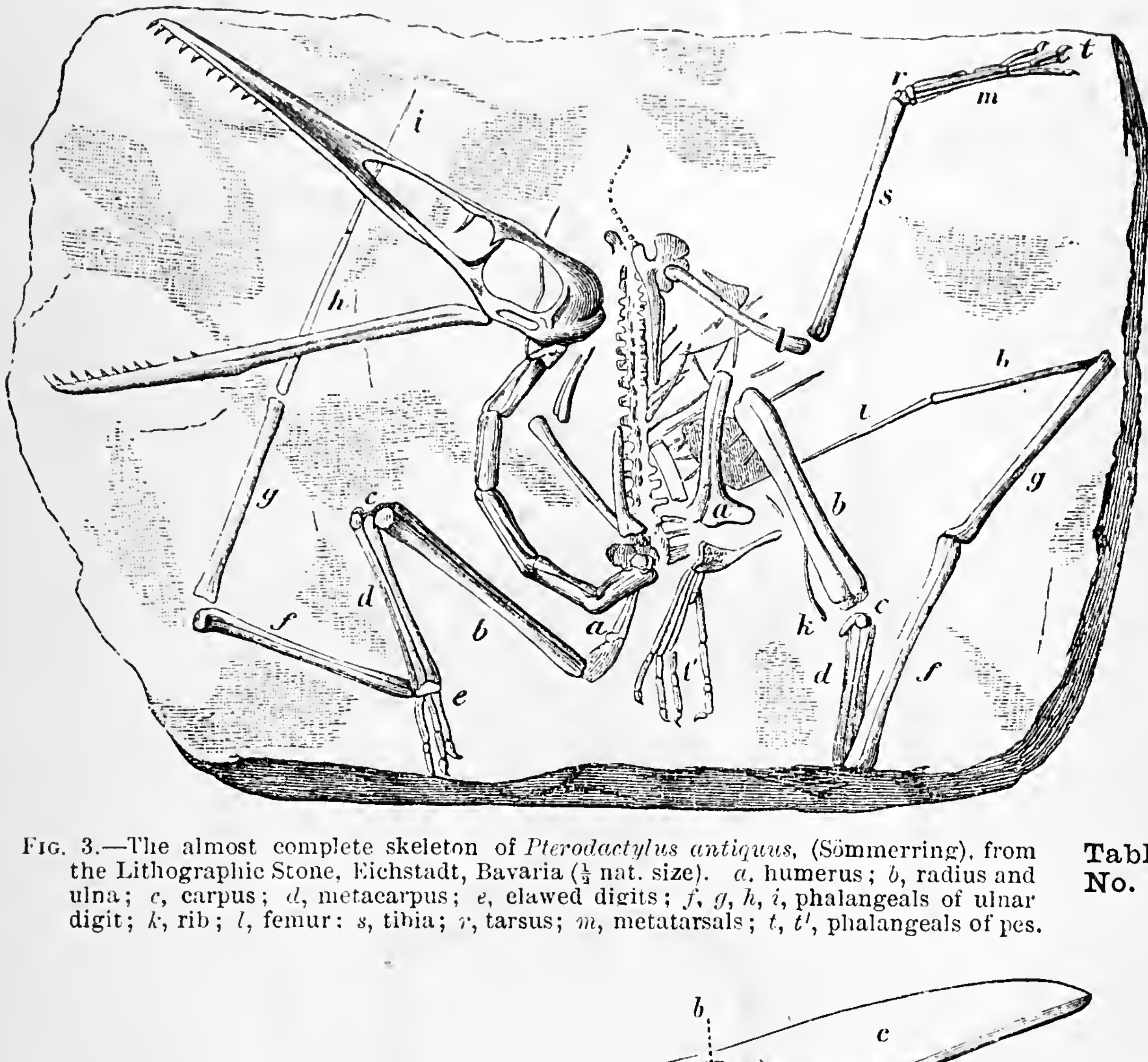


Fig. 3.—The almost complete skeleton of *Pterodactylus antiquus*, (Sömmerring), from the Lithographic Stone, Eichstadt, Bavaria ($\frac{1}{3}$ nat. size). *a*, humerus; *b*, radius and ulna; *c*, carpus; *d*, metacarpus; *e*, clawed digits; *f*, *g*, *h*, *i*, phalangeals of ulnar digit; *k*, rib; *l*, femur: *s*, tibia; *r*, tarsus; *m*, metatarsals; *t*, *t'*, phalangeals of pes.

Table-case, No. 1.

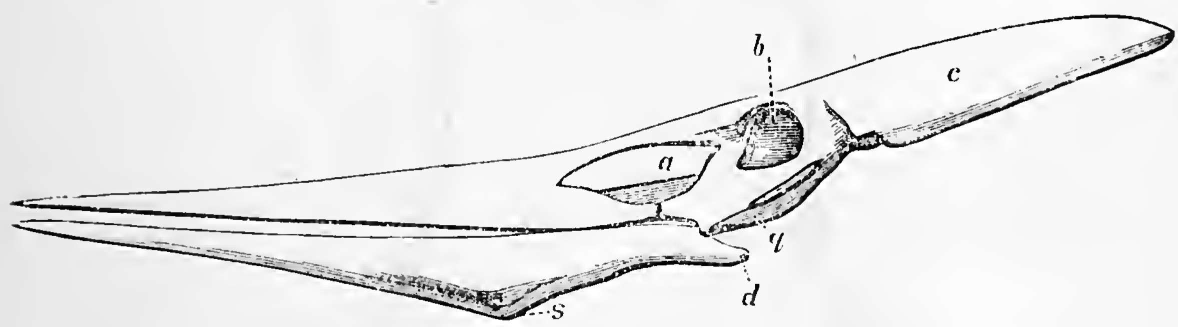


Fig. 4.—Left lateral view of skull of *Pteranodon longiceps* (Marsh), from the Cretaceous of North America ($\frac{1}{12}$ nat. size). *a*, preorbital vacuity; *b*, orbit; *c*, supraorbital crest; *d*, angle of mandible; *q*, quadrate; *s*, symphysis. (Not represented in the Collection.)

of these English examples is the *Dimorphodon macronyx* from the Lias of Lyme, which had a large head, the jaws armed with lancet-shaped teeth, a long tail, and well-developed wings. The skull was 8 inches in length, and the expanse of the wings about 4 feet (*see* Fig. 5).

Dimorphodon.
Wall-case, No. 1.

Many remains have been discovered by Prof. Marsh in the Chalk of North America. One singular form, named by him

Pterodactyles. Wall-case, No. 1.

Pteranodon, had no teeth in its jaws, which were a yard in length, sharp-edged and pointed, and were probably encased in a horny sheath like the beak of a stork or heron (*see* Fig. 4).

Table-case, No. 1.

The Flying Lizards of the Chalk and Greensand attained even a larger size—but their remains are all very fragmentary. For example, some detached vertebræ of the neck of one species have been found in the Cambridge Greensand, measuring 2 inches in length, and portions of humeri 3 inches broad. Such bones give evidence of a flying lizard having probably an expanse of wings of from 18 to 20 feet. The Pterodactyles of the Chalk of Kent were nearly, if not quite, as large.

The smallest species of Pterodactyle from Solenhofen was not larger than a sparrow (*see* Table-case No. 1). These singular flying reptiles do not appear to have lived longer than the period of time represented by the deposition of the strata from the Lias formation to the Chalk, their remains being confined to rocks of the Secondary, or Mesozoic age. They are now entirely extinct.

Fig. 5.—Skeleton of *Dimorphodon macronyx* (Owen), L. Lias, Lyme Regis, Dorset. *m*=manus; *f*=wing-finger; *p*=foot.

Order II.—CROCODILIA. (Crocodiles.)

Crocodiles. Wall-case, No. 2, and Table-cases, Nos. 2 to 7.

The Crocodilia (which are placed in Wall-case No. 2, and in Table-cases Nos. 2–7) have the body covered with a thick layer of oblong bony plates or scutes, pitted on the surface, and covered with a horny substance. They have a single row of pointed and subconical or laterally compressed teeth in

distinct sockets, which are continually being renewed from below. The skull is relatively large in proportion to the body, and is usually much depressed; its component bones are firmly united and generally have a characteristic sculpture on their external surface. The palatines and pterygoids unite in the middle line and thus close the palate, and very frequently one or both of these paired bones develop inferior plates, which meet beneath the narial passages. The quadrate is tightly wedged in

Crocodilia. Wall-case, No. 2.

Table-cases, Nos. 2 to 7.

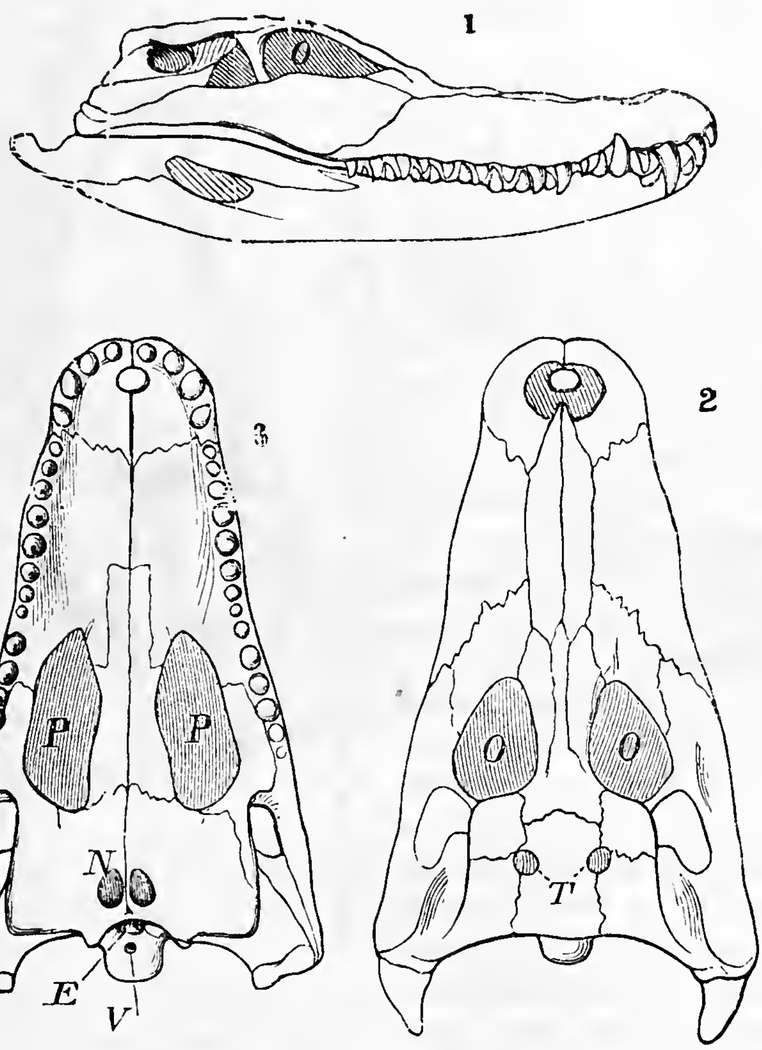


FIG. 6.—*Crocodilus palustris* (Lesson). 1, lateral, and 2, upper views of skull; 3, palatal view of cranium; *E*, aperture of median eustachian canal; *N*, posterior nares; *O*, *O*, orbits; *P*, *P*, palato-pterygoid vacuities; *T*, supra-temporal fossæ; *V*, basi-occipital. The figures are much reduced. Common, living in Western India. Fossil in the Pleistocene deposits of the Narbada Valley, India.

among the adjacent bones; the tympanic cavities usually communicate with the mouth by three eustachian canals; the mandibular symphysis unites by suture; there are, as a rule, no ossifications in the sclerotic of the eyeball. There is almost invariably a lateral vacuity in the mandible. The vertebræ of these reptiles are cup-shaped or concave at both ends, as in *Teleosaurus*; or concave in front and convex behind, as in the Crocodile from Sheppey (Fig. 7) and in all living Croco-

Crocodilia.
Wall-case, No. 2.
Table-case, No. 3.

diles. Professor Owen has constituted two groups, based on these modifications of the vertebræ. The Crocodiles belong to the procœlian section (vertebræ concave in front), and are divided into a *brevirostrine*, or short-snouted section, containing the Alligator, the Crocodile, and the Tertiary genus *Diplocynodon;* and a *longirostrine*, or long-snouted section, embracing the Garials, *Tomistoma*, *Thoracosaurus*, and *Rhamphosuchus*.

The *Amphicœlian* section (vertebræ concave at both ends), embraces *Hylæochampsa*, also a second brevirostrine section including *Theriosuchus*, *Goniopholis*, *Nannosuchus*, and *Oweniasuchus*, and a second longirostrine section for *Pholidosaurus* and *Petrosuchus*, all from the Wealden and Purbeck beds.

Belodon.
Wall-case, No. 2

The older secondary forms belong to the Teleosauridæ as *Dacosaurus*, *Metriorhynchus*, *Teleidosaurus*, *Machimosaurus*, *Pelagosaurus*, *Steneosaurus*, and *Teleosaurus*. The earliest of these Crocodilian reptiles is named, *Belodon* (Fig. 8), having long and pointed slightly-curved teeth, longitudinally grooved, and

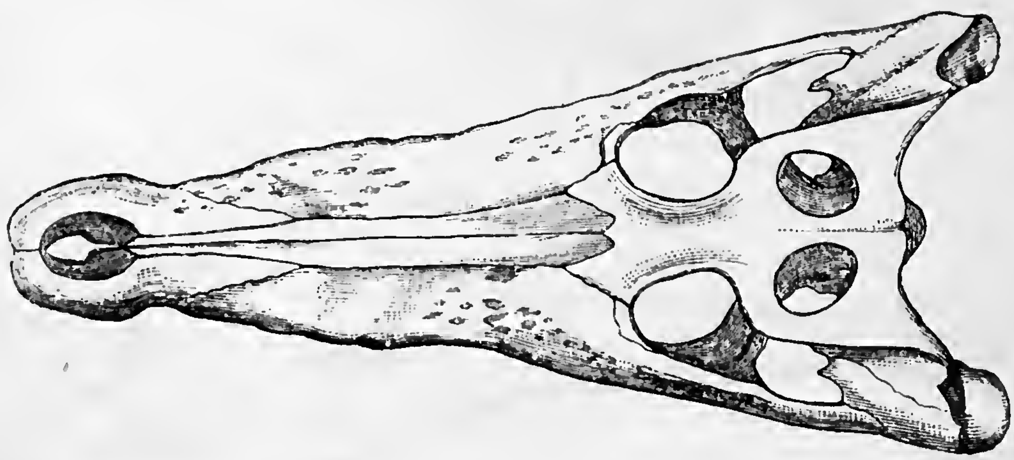


Fig. 7.—*Crocodilus Spenceri* (Buckland). Upper view of skull restored, from the London Clay of Sheppey (about ⅓ nat. size).

with elongated jaws like the modern Garials; the other, named *Stagonolepis*, resembled the existing Caimans, but with an elongated skull like the Garials; the body was covered by bony scutes. Both these reptiles are from the Trias, the former from Stuttgart, Germany; the latter from Elgin, Scotland. In the Oolitic and Liassic series the old type of long and slender-jawed Teleosaurs and Steneosaurs (Figs. 9 and 11), with strong bony scutes, was abundantly represented.

Wall-case, No. 2.
Geosaurus.

Here are exhibited the type specimens of *Geosaurus*, from the lithographic stone (Upper Oolite) of Solenhofen, Bavaria. Baron Cuvier inferred, from the form and structure of its skull, that *Geosaurus* held an intermediate place between the crocodiles and the monitors, but was more nearly related to the latter. The orbits are large and the eyes were protected by bony sclerotic plates, like those of *Ichthyosaurus*. It had

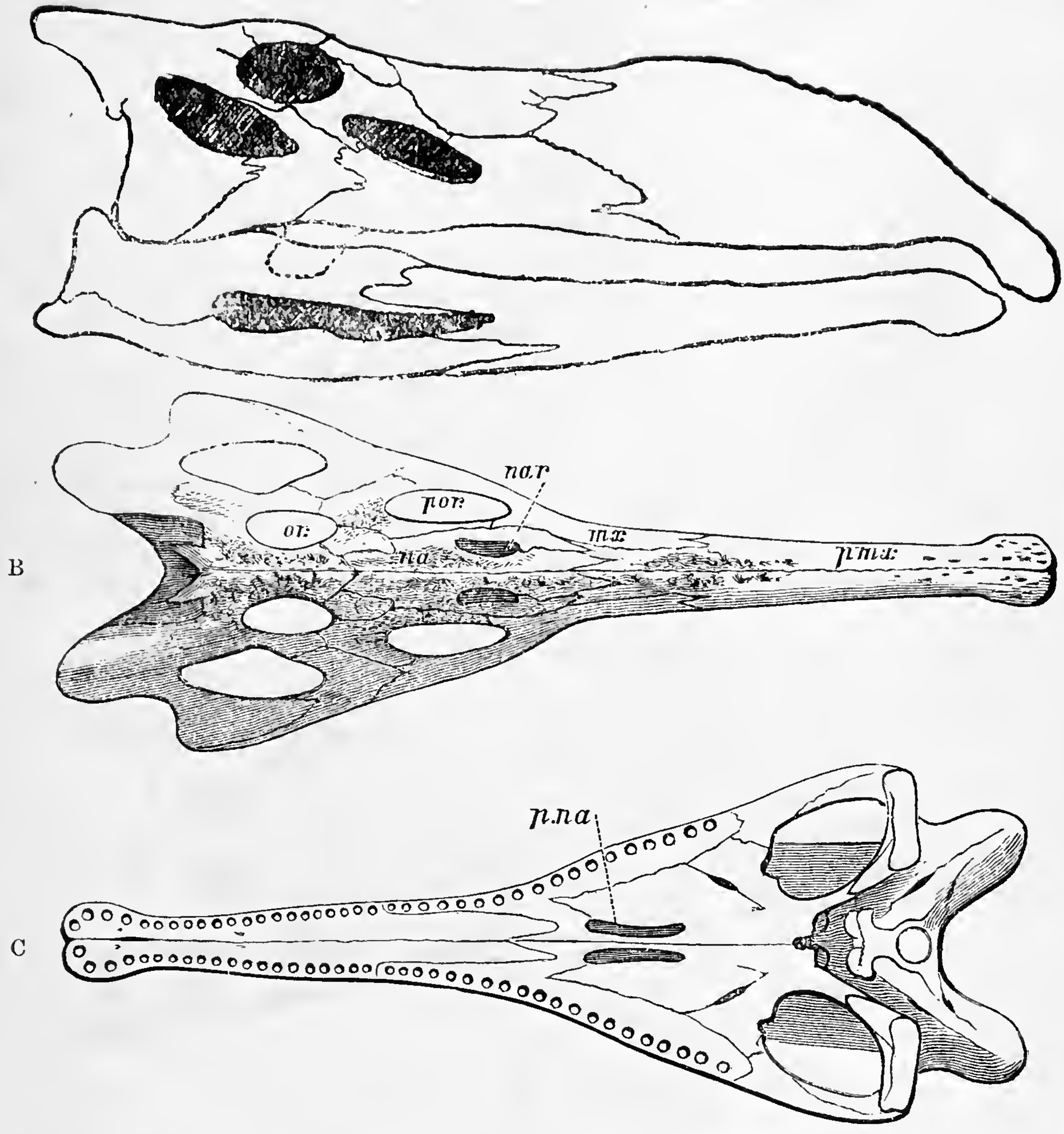


FIG. 8.—*Belodon Kapffii* (Meyer); from the Keuper, Upper Trias, Stuttgart, Wurtemberg. A, lateral view of skull; B, upper view of skull; C, palatal aspect of same; *pmx*, premaxilla; *mx*, maxilla; *na*, nasal; *nar*, nares; *or*, orbit; *por*, preorbital vacuity; *pna* posterior nares (greatly reduced).

FIG. 9.—Upper view of cranium of *Steneosaurus Heberti* (E. Geoffroy); from the Lower Oxfordian of Normandy (about $\frac{1}{12}$ nat. size).

BELODON AND STENEOSAURUS.

Wall-case, No. 2.

numerous, large, compressed, and slightly recurved teeth, and the vertebræ are constricted and biconcave. It probably attained a length of ten or twelve feet. The original specimens from Monheim, first described and figured by Sœmmerring in 1816, as a gigantic lizard *(Lacerta gigantea)* are exhibited in the case.

Fig. 10.—Tooth of *Dacosaurus maximus* (Plien.) Kimmeridge Clay, Ely.

In *Dacosaurus*, the skull is short and broad, with no trace of premaxillary expansion and without sculpture; the teeth are few in number, stout, smooth, and with two slightly serrated carinæ and a suboval cross-section. (*See* woodcut, Fig. 10.)

Pelagosaurus. Glazed-case X.

A reproduction of the entire skeleton of the *Pelagosaurus typus*, from the Lias of Curcy, Normandy, prepared by the late Professor E. Deslongschamps, is placed in a glazed case between Table-cases Nos. 10 and 11, and marked X on plan.

Table-case, No. 4.

From the Wealden of the South-east of England, the Purbeck beds of Dorset, we have a true Crocodilian, the *Goniopholis*; and a dwarf species, *Theriosuchus pusillus*, Owen (Table-case No. 4).

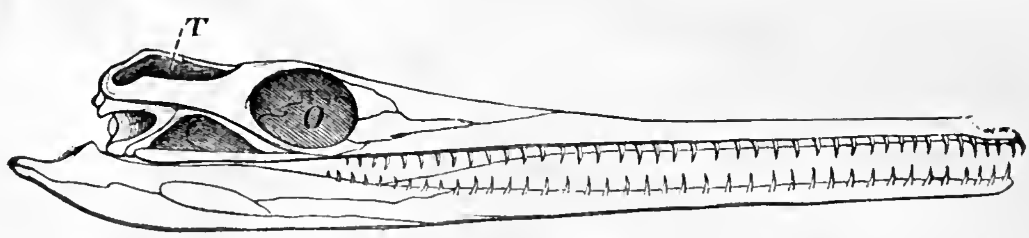


Fig. 11.—Profile of skull of *Pelagosaurus typus* (Bronn), from the Upper Lias of Normandy (reduced). *T*, supra-temporal fossa; *O*, orbit.

Wall-cases, Nos. 1 and 2. Table-cases, Nos. 2 and 3.

A large Crocodile has been obtained from the Eocene Tertiary of the Isle of Wight, and from Hordwell, Hampshire: and remains of many species of Crocodiles and Garials, from the Tertiary rocks of India, may be seen in the wall-case. These are referable to the typical genus *Crocodilus*, and also to the other living genera, namely, *Garialis* of India and *Tomistoma* of Borneo; both the last-named genera being long-snouted types.

Order III.—DINOSAURIA.

Wall-cases, Nos. 3—7, and Table-cases, Nos. 7 to 10.

The Dinosauria, Land-Reptiles.—This remarkable group of huge terrestrial reptiles is quite extinct. Some of them had bony dorsal plates and long and formidable spines (as *Acanthopholis*, *Polacanthus*, *Hylæosaurus*, &c.), others were without such defences. Most of these animals had flat or

Dinosauria.

biconcave centra to their vertebræ, the anterior (cervical) vertebræ had hollow cups behind. Two pairs of limbs were always present, furnished with strong-clawed digits.

They were probably to some extent amphibious in their habits, but their limbs were well fitted for progression on the land.

The group has been provisionally sub-divided into the following sub-orders, namely:—

SUB-ORDER 1.—**Sauropoda** (Lizard-footed).

Atlantosaurus. Wall-case, No. 3.

The members of this group of Dinosaurs were all herbivorous, and included some of the largest forms hitherto discovered, by far the hugest being the American genus *Atlantosaurus*, from the Jurassic of Colorado. Although no entire skeleton has been found, it is supposed to have attained a

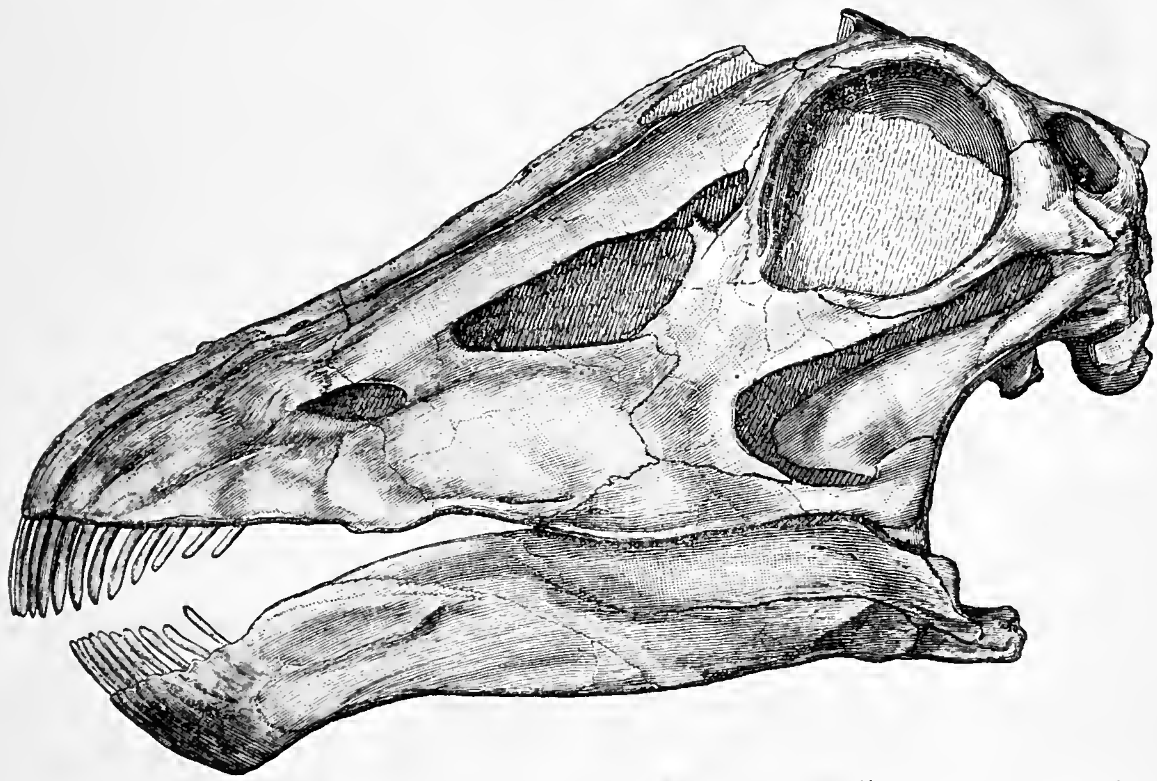


FIG. 12.—Lateral view of skull of *Diplodocus longus* (Marsh), from the "*Atlantosaurus*" beds (Upper Jurassic), near Cañon City, Colorado, N. America ($\frac{1}{6}$ nat. size). (Not yet represented in the Collection.)

length of over 80 ft., and a height of 30 ft., as from the structure and relative proportions of the fore and hind limbs, it is assumed that these huge reptiles walked in an erect, or a semi-erect position, on their hind-feet. A plaster-cast of a thigh-bone (femur) shown in this case is 6 ft. 3 in. long.

Another remarkable genus, from the same horizon and locality, is the *Diplodocus*, an animal intermediate in size between *Atlantosaurus* and *Morosaurus*, which may perhaps have attained to 40 or 50 feet in length, when living. The teeth indicate that it was herbivorous and its food was probably succulent vegeta-

tion. There are no examples of *Diplodocus* at present in the Collection.

Cetiosaurus, or "Whale Lizard."

The *Cetiosaurus*, or "Whale-Lizard," thus named by Sir Richard Owen, from some resemblance in the form and structure of the posterior vertebræ to those of a whale (it must be borne in mind that the Cetiosaurs have really *no affinities* to the whales in any way whatever, save in name!) is another genus of these huge Saurians, whose remains are found in our own island, and of which three species are recorded, the earliest in geological time being the *C. longus* (Owen). Of this species a large portion of a skeleton of the same animal was discovered in 1870, in the Great Oolite at Enslow Bridge, near Oxford, and is preserved in the Oxford University Museum; but plaster-casts of the large bones of the extremities are placed in the case. The femur is 5½ ft. long, and the humerus 4 ft. 3 inches. The anterior vertebræ are large, with cup and ball articulations, they have large cavities in the centra, and are buttressed like those of *Ornithopsis*, an allied genus. A huge arm-bone (humerus) nearly 5 ft. long, from the Kimmeridge Clay, Weymouth, has been referred to this genus, under the name of *C. humero-cristatus*; it is at present the only evidence of the species known. *C. brevis*, from the Wealden of Sussex and the Isle of Wight, is represented by caudal and dorsal vertebræ, &c., including the original specimens from Dr. Mantell's collection, upon which the genus was founded.

Ornithopsis.

Wall-case, No. 3.

Here are exhibited a series of vertebræ and other remains of a huge Dinosaur, named *Ornithopsis Hulkei* (Seeley) obtained from the Wealden formation, Brixton, Isle of Wight.

Ornithopsis was remarkable for the extreme lightness in construction of the bones of its neck and back, combined with great strength. A single dorsal vertebra had a centrum 10 inches long, and 25 inches in circumference at the front or convex end, whilst it measured in height to the summit of the dorsal spine 25 inches; and in breadth across the transverse processes 19 inches. A single centrum of one of the cervical or neck vertebræ measures 32 inches in length.

The centrum of each vertebra is composed of highly cellular bony tissue (like the frontal portion of the skull of the elephant), and has a large cavity on each side.* The dorsal and cervical vertebræ are opisthocœlous (*i.e.*, hollow behind, and convex in front), and each had articulations for a double-headed rib. The spinous processes are convex, and greatly developed, being rendered at the same time both extremely light and strong by struts and buttresses and thin sheets of bone, with large and deep recesses between.

* This cellular structure disappears as we reach the posterior vertebræ of the sacral and caudal series, which are solid and destitute of the cavities characteristic of the thoracic and cervical vertebræ.

Brontosaurus.

The discovery of the entire remains of a huge Dinosaur in America, which when alive was nearly, or quite, fifty feet in length, named by Prof. Marsh, *Brontosaurus*, with dorsal

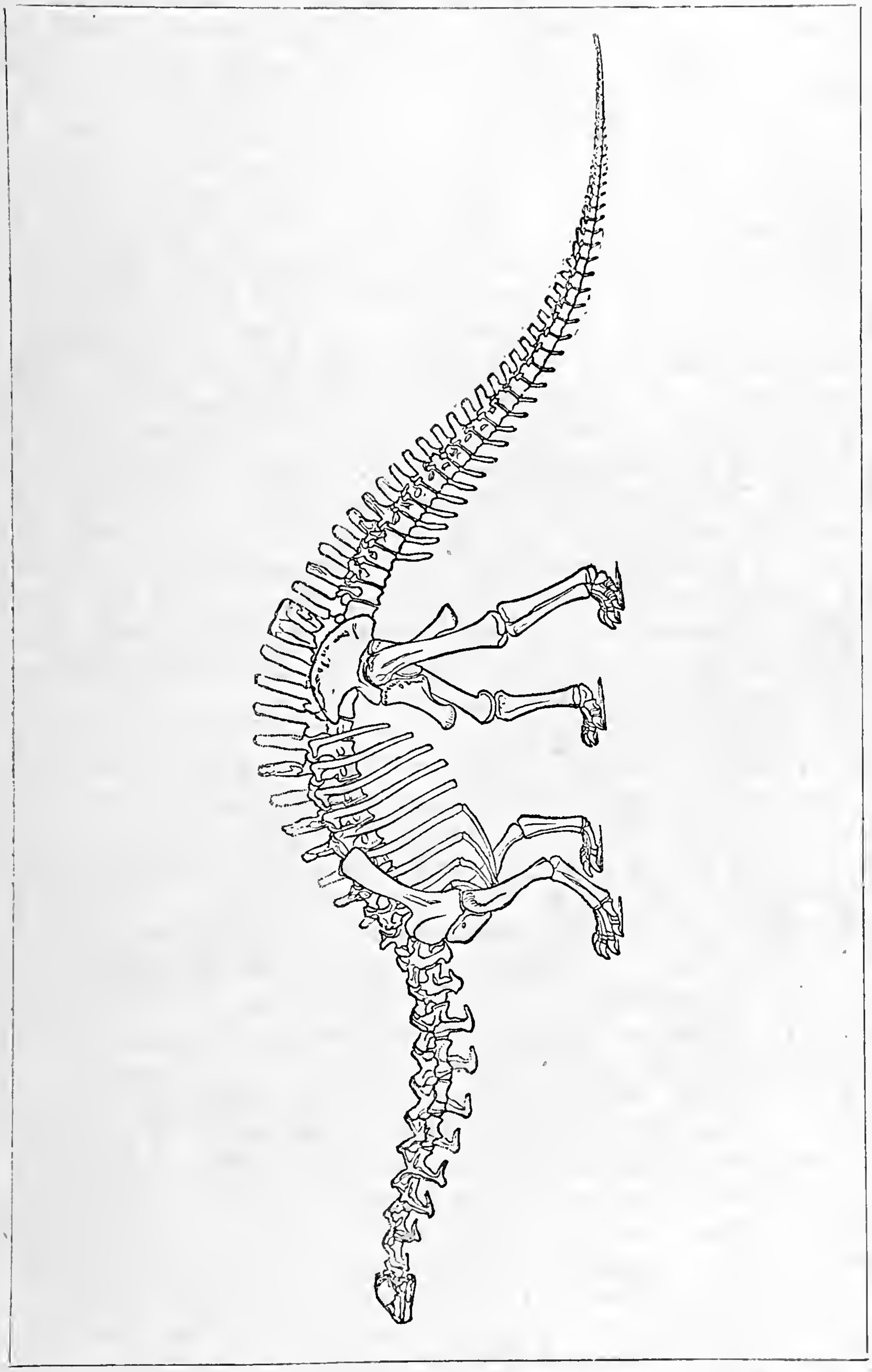


Fig. 13.—Restoration of *Brontosaurus excelsus*, (Marsh), from the Jurassic formation of Colorado, N. America ($\frac{1}{150}$ nat. size). (Not represented in the Collection.)

vertebræ constructed upon the same type as *Ornithopsis*, fully confirms the accuracy of the conclusions arrived at by Prof. Seeley and Mr. Hulke as to the affinities of the latter animal.

Ornithopsis. Wall-case, No. 3.

It seems almost certain that the detached tooth described as *Hoplosaurus armatus*, and the cervical and dorsal vertebræ and pelvis, described under the names of *Ornithopsis Hulkei* and *O. encamerotus*, are referable to the same form. The head in *Brontosaurus*, with which genus *Ornithopsis* has been compared, was very diminutive in comparison with the size of its huge vertebræ and limb-bones (*see* Fig. 13).

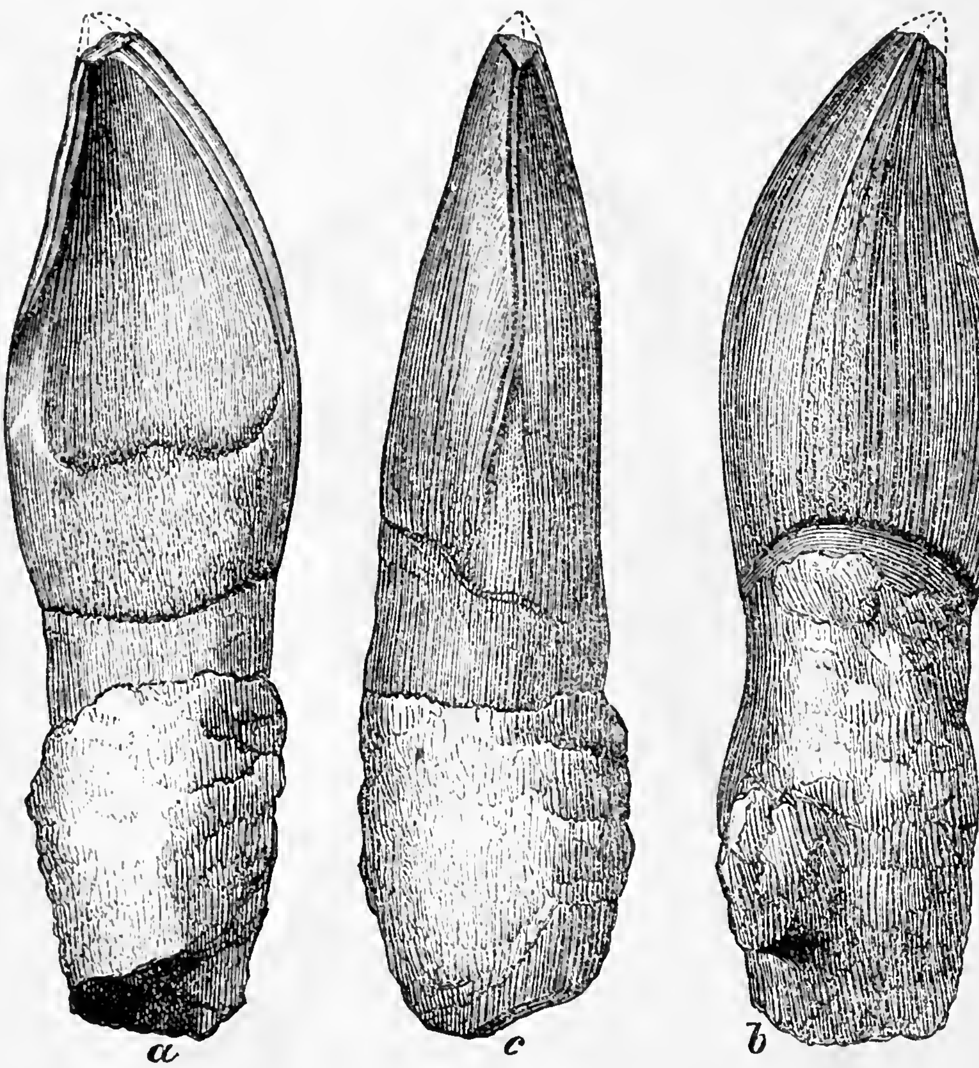


Fig. 14.—(*a*) inner; (*b*) outer; (*c*) profile views of a tooth of *Hoplosaurus armatus* (Gervais), from the Wealden of the Isle of Wight, 1/1.

Pelorosaurus.

Pelorosaurus, another large land Saurian of the Wealden period, is referred to this sub-order. It probably exceeded, in size the largest Iguanodons, and is represented in the Collection by the humerus, which is 52 inches in length.

Another humerus noticed above (p. 10) as having been referred to *Cetiosaurus humerocristatus*, by Hulke, probably belongs to this same genus. The cast of a vertebra from the Oxford Clay, near Peterborough, also may be referred to another species of this genus, and is remarkable for its large size.

SUB-ORDER 2.—**Theropoda** (Beast-footed).

Wall-case, No. 7.

The THEROPODA hold an intermediate position between the Sauropoda and the Ornithopoda, although more nearly allied to the former. In the structure of the teeth, the form of the femur; the occasional presence of only two sacral vertebræ, and in the form of the quadrate bone, certain genera approach more nearly to the Crocodilia than even do the Sauropoda; although in their hollow limb-bones they agree with the

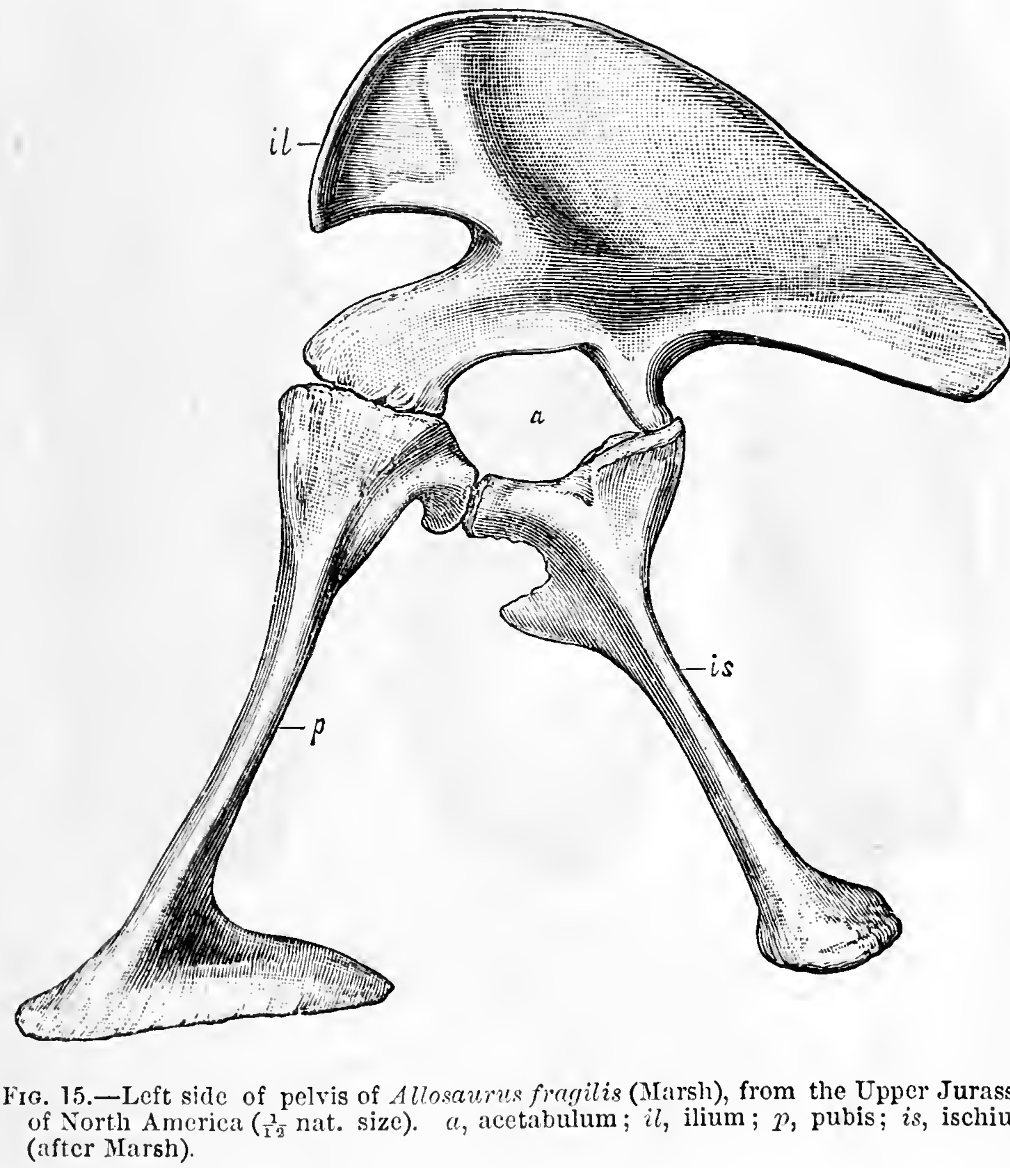


FIG. 15.—Left side of pelvis of *Allosaurus fragilis* (Marsh), from the Upper Jurassic of North America ($\frac{1}{12}$ nat. size). *a*, acetabulum; *il*, ilium; *p*, pubis; *is*, ischium (after Marsh).

Ornithopoda. All the forms were carnivorous. The premaxillary was furnished throughout with teeth, which are laterally compressed and backwardly curved, the cutting edges of one or both of which are frequently serrated. The teeth are planted in distinct sockets, and the skull has a large aperture in front of the eye, known as the preorbital vacuity. The centra of all the vertebræ are hollowed internally, and much compressed laterally.

Wall-case, No. 7.

Table-case, No. 9.

The limb-bones always have medullary cavities, and the pectoral (fore-) limb being much shorter than the pelvic (hind-) limb, it is probable that many of the forms were bipedal in their

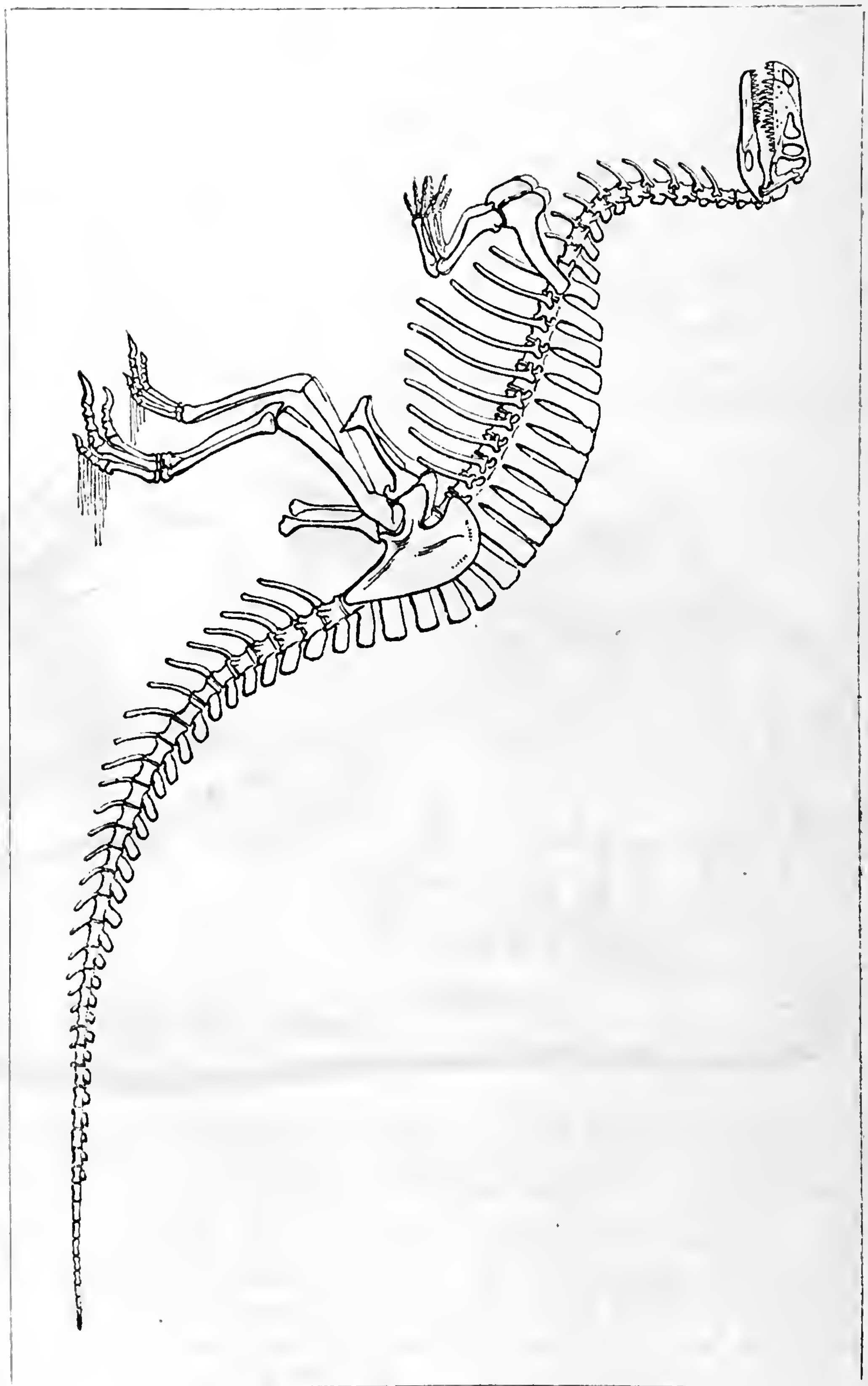


Fig. 16.—Restoration of the skeleton of *Megalosaurus Bucklandi* (Meyer), from the Great Oolite, Stonesfield (greatly reduced).

habits, although some of them may have been quadrupedal. In the pelvis (*see* Fig. 15) the ilium is of great vertical depth, and has a short preacetabular process, while the pubis is directed

downwards and forwards, and unites with its fellow in a long bony symphysis, which generally extends up the anterior face of the two bones, giving them the shape of an elongated letter Y, when seen from the front. The pubis and ischium are comparatively short and slender. The *astragalus*, or "ankle-bone," usually fits closely to the tibia, and frequently gives off a long flattened process which is applied closely to the anterior face of the latter bone, resembling in this respect the free condition of these two bones in the young of Ratite birds before the anchylosis of the astragalus with the tibia has taken place.

The metatarsals are elongated and the feet digitigrade. In the manus (hand), the number of digits varies from four to five, while in the pes (foot), there may be either three or five. The terminal phalangeals in all cases have curved claws, which in the manus are very long and prehensile, evidently well adapted for seizing and holding living prey.

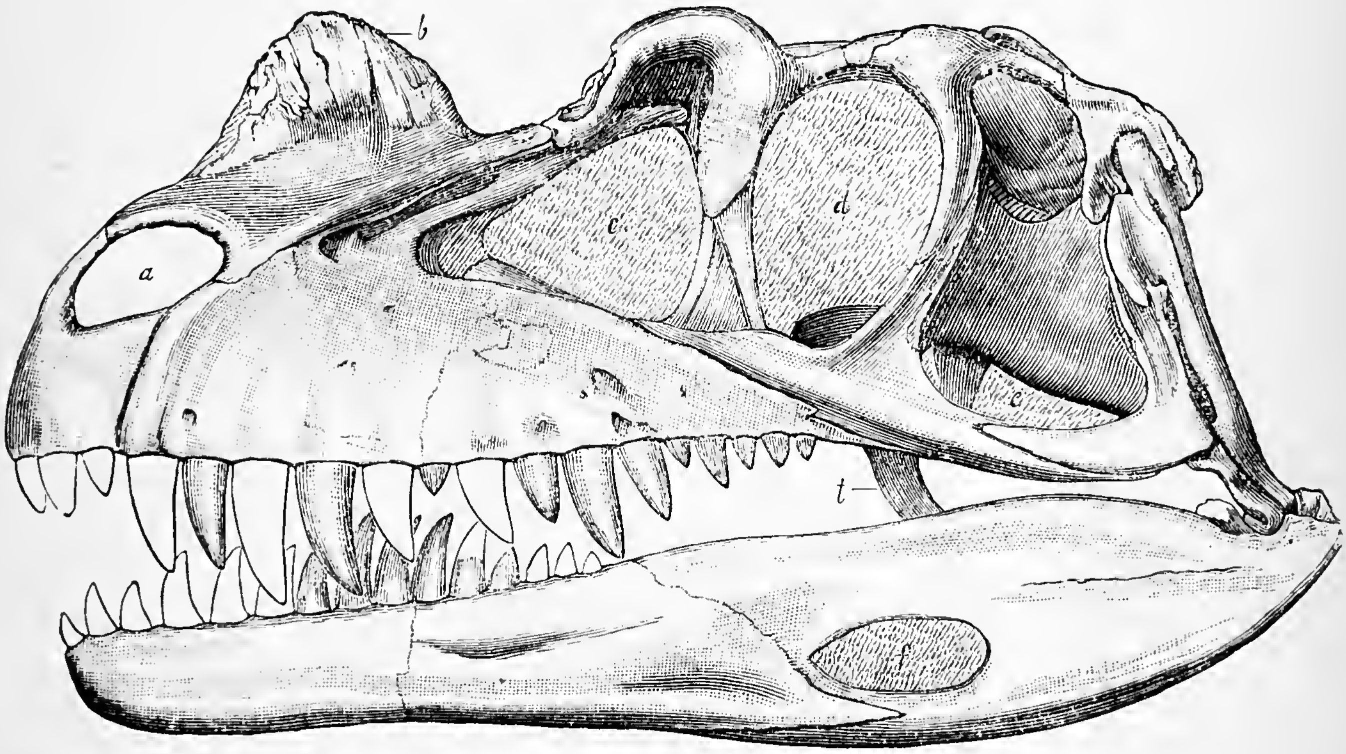


FIG. 17.—Left lateral view of skull of *Ceratosaurus nasicornis* (Marsh), from the Upper Jurassic, North America. *a*, nasal opening; *b*, horn-core; *c*, antorbital opening; *d*, orbit; *e*, lower temporal fossa; *t*, transverse bone: *f*, mandibular vacuity ($\frac{1}{6}$ nat. size) after Marsh. (Not represented in the Collection.)

Compsognathus.

Table-case, No. 9.

The skeleton of a small Dinosaur, of which a beautiful cast may be seen in Table-case No. 9, the original being preserved at Munich, named *Compsognathus longipes*, has been found entire in the Lithographic stone of Solenhofen. From the relative proportions of its limbs we cannot but conclude that it must have "hopped (like a Jerboa), or walked in an erect or semi-erect position, after the manner of a bird, to which its long neck, slight head, and small anterior limbs must have given it an extraordinary resemblance." (Huxley.)

Teratosaurus. Megalosaurus. Table-case, No. 9.

Numerous other fine Dinosaurian remains are to be seen in the collection, but as we do not know the teeth of many of these huge reptiles, we cannot speak positively as to their habits. It is certain, however, that, from the Trias to the Chalk, two groups have existed, one having a carnivorous dentition, and the other being herbivorous. *Teratosaurus* of the Trias of Stuttgart, *Ceratosaurus* and *Allosaurus* of the American Jurassic rocks, *Megalosaurus* and *Compsognathus* of the Oolitic and Wealden strata were all carnivores.

Wall-case, No. 4.

The actual counterpart and casts of the maxilla and premaxilla and a portion of the ramus of the lower jaw of *Megalosaurus* from the Inferior Oolite, Sherborne, Dorset, may be seen in the Wall-case. Of *Polacanthus*, *Omosaurus*, *Hylæosaurus*, and *Cetiosaurus* * we have no direct dental evidence, but judging from a comparison of the other portions of their skeletons, they have been referred to the family of the Stegosauridæ. No doubt, as amongst the Mammalia at the present day, the majority were vegetable-feeders, and the minority were predaceous in habit. The Cretaceous genus *Lælaps*, and the Jurassic *Ceratosaurus* and *Allosaurus* were, in America, the representatives of the carnivorous *Megalosaurus* of our Secondary rocks.

Lælaps.

Megalosaurus. Wall-case, No. 7.

Many species of *Lælaps* have been identified, and a series of plaster-casts of bones of *Lælaps aquilunguis* are exhibited in the case.

ANCHISAURIDÆ.—The genus *Anchisaurus* has amphicœlous cervical vertebræ, the pubis is rod-like, there are five digits in the manus and pes. The teeth are without serrations on the anterior border. *Epicampodon* (Fig. 18, A, B, C) is an allied genus from India.

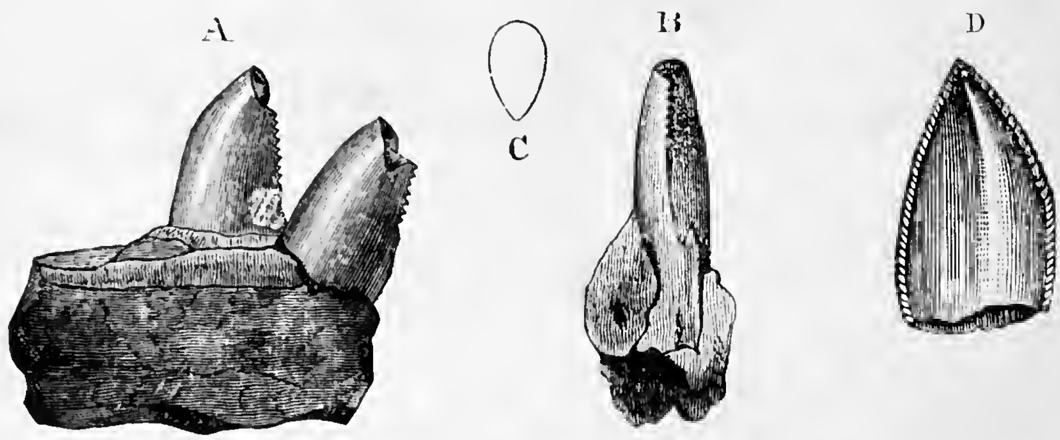


FIG. 18.—Fragment of mandible, *A*, lateral aspect; *B*, posterior aspect; *C*, section of tooth of *Epicampodon indicus* (Huxley), from the Panchet beds (U. Trias), Lower Gondwanas of Bengal; *D*, lateral aspect of tooth of *Thecodontosaurus platyodon* (Riley & Stutchbury), Upper Trias, Bristol.

* A single detached tooth has been found in the same quarry at Enslow Bridge, near Oxford, from which the bones of *Cetiosaurus* were obtained; it is somewhat like that of *Hoplosaurus*.

In *Thecodontosaurus platyodon* (Fig. 18,D), the teeth have oblique serrations on both borders. The ilium is of the Megalosaurian type. Remains of this genus are met with in the Upper Trias, Durdham Down, Clifton, near Bristol, in Gloucestershire. **Wall-case, No. 7.**

SUB-ORDER 3.—**Ornithopoda** (Bird-footed).

This sub-order is taken to include the STEGOSAURIA of Marsh. **Wall-case, No. 4.**

The genus *Stegosaurus* was originally described by Marsh from the Upper Jurassic of North America, but certain forms from the Oxford and Kimmeridge Clay of England, described under the preoccupied name of *Omosaurus*, cannot be separated generically from *Stegosaurus*. They also agree with the *Scelidosauridæ* in the general structure of their teeth and in the possession of a dermal armour of scutes and spines, as well as in their solid limb-bones.

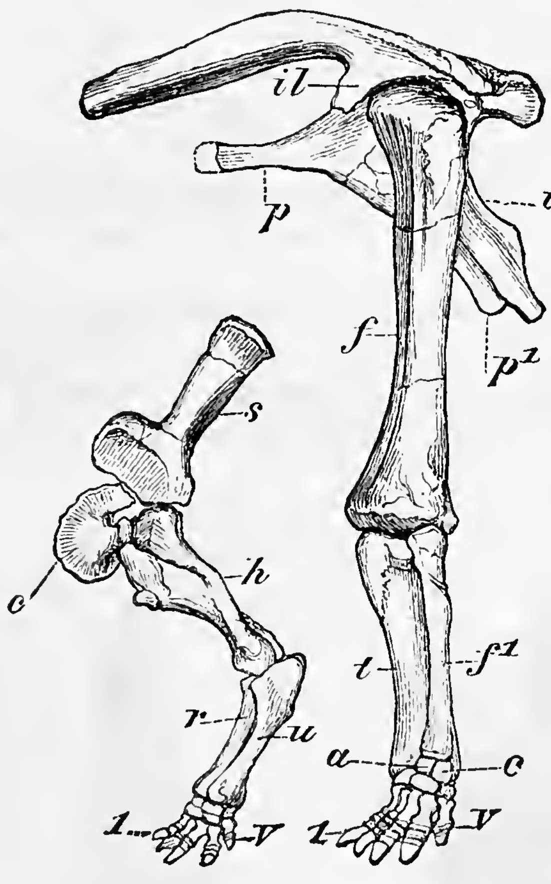


FIG. 19.—The left pectoral and pelvic girdles and limbs of *Stegosaurus ungulatus* (Marsh), from the Upper Jurassic of Southern Colorado, North America ($\frac{1}{32}$ nat. size), *s*, scapula; *c*, coracoid; *h*, humerus; *r*, radius; *u*, ulna; I-*V*, phalangeals; *il*, ilium; *is*, ischium; *p*, *p* 1, pubis; *f*, femur; *t*, tibia; *f* 1, fibula; *a*, astragalus; *c*, calcaneum (after Marsh).

The neural arches of the vertebræ are very much higher, and in the sacrum each arch is chiefly or entirely supported by a single centrum, instead of by the adjacent portions of two centra as in the Ornithopoda.

The skull shows many points of resemblance to that of *Iguanodon*, especially by the presence of a predentary bone, but it is lower and narrower and in this respect it resembles the Scelidosaurian type.

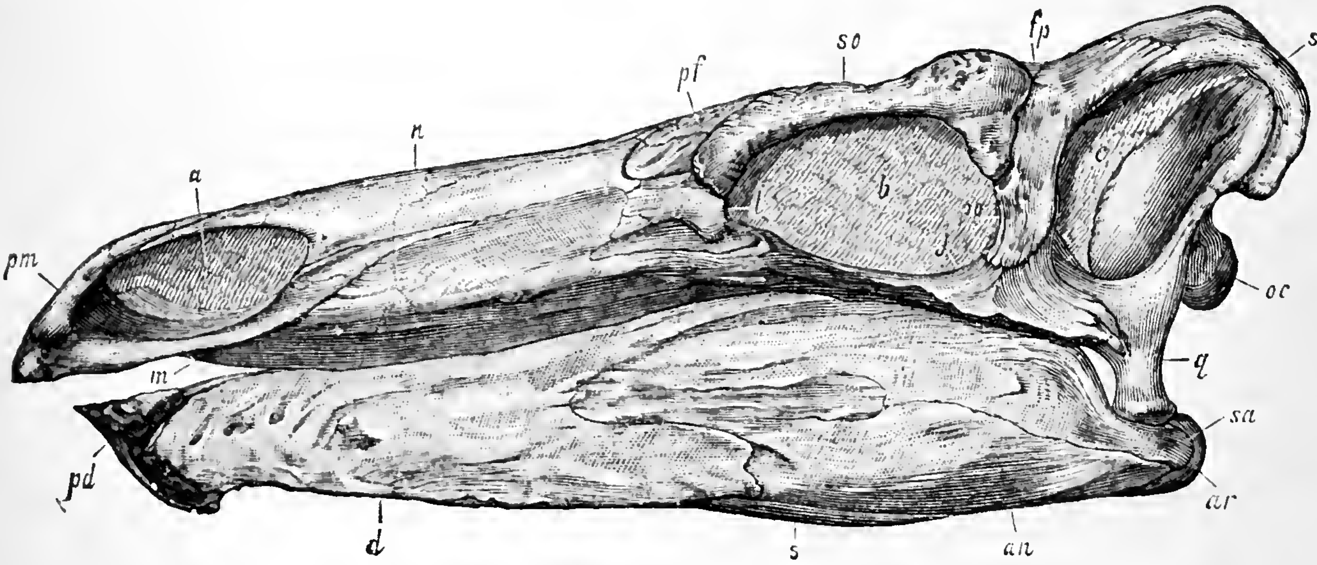


Fig. 20.—Left lateral view of skull of *Stegosaurus stenops* (Marsh), $\frac{1}{4}$ natural size; from the Upper Jurassic, S. Colorado, North America. *a*, nares; *b*, orbit; *c*, infra-temporal fossa; *pm*, premaxilla; *m*, maxilla; *n*, nasal; *pf*, prefrontal; *so*, supra-orbital; *fp*, postfrontal; *po*. postorbital; *l*, lachrymal; *j*, jugal; *q*, quadrate; *sq*, squamosal; *oc*, occipital condyle; *ar*, articular; *sa*, surangular; *an*, angular; *s*, splenial; *d*, dentary; *pd*, predentary (after Marsh).

To this sub-order are referred the remains of a large Dinosaur from the Kimmeridge Clay of Swindon, Wilts, described by Sir Richard Owen in his Monograph on the Fossil Reptilia of the Mesozoic Formations (Palæontographical Society's Volume for 1875), under the name of *Omosaurus armatus*. The series comprises, in an immense block, the iliac bones of either side with the entire sacrum, retaining the normal form and position, an ischium, a femur, several dorsal and caudal vertebræ projecting in bold relief from the background of grey stone, forming a magnificent fossil group unique of its kind.

Omosaurus.

In addition to the bones above mentioned (which are all imbedded in one block 6′ 0″ × 7′ 6″), a large dermal spine, several centra and processes of many vertebræ and chevron-bones, an entire humerus, ulna and radius with carpal and metacarpal bones, all parts of the same fore-limb; also a complete ischium and pubis, and six caudal vertebræ, were found lying in the clay around the larger mass.

The femur measures more than 4 feet, and the humerus is nearly 3 ft. in length and enormously broad. The head and neck are unfortunately wanting, but there is little doubt that nearly the entire animal might have been obtained had some competent person been present in the pit when the remains were first observed.

Scelidosaurus, Case Y, on Plan.

FIG. 21.— A single upper tooth of *Scelidosaurus Harrisoni* (Owen) twice nat. size, from the Lower Lias, Charmouth, Dorset.

A large plated Dinosaur has been discovered in a tolerably perfect state, and is placed in a glazed case in the centre of the Reptile gallery.

It was obtained from the Lower Lias of Lyme Regis, Dorset, and is a fairly complete skeleton of an herbivorous Dinosaur about 12 feet in length, closely allied by its dentition to *Iguanodon*, and described by Sir Richard Owen as *Scelidosaurus Harrisoni*. This reptile was armed with lateral rows of thick bony scutes or spines on each side, which extended along the tail also. There is very considerable disparity between the fore and hind-limbs, as in so many other Dinosaurs. There are four functional toes and one rudimentary one on the hind foot; the fore-foot is not well preserved and the number of digits cannot consequently be clearly made out in the hand.

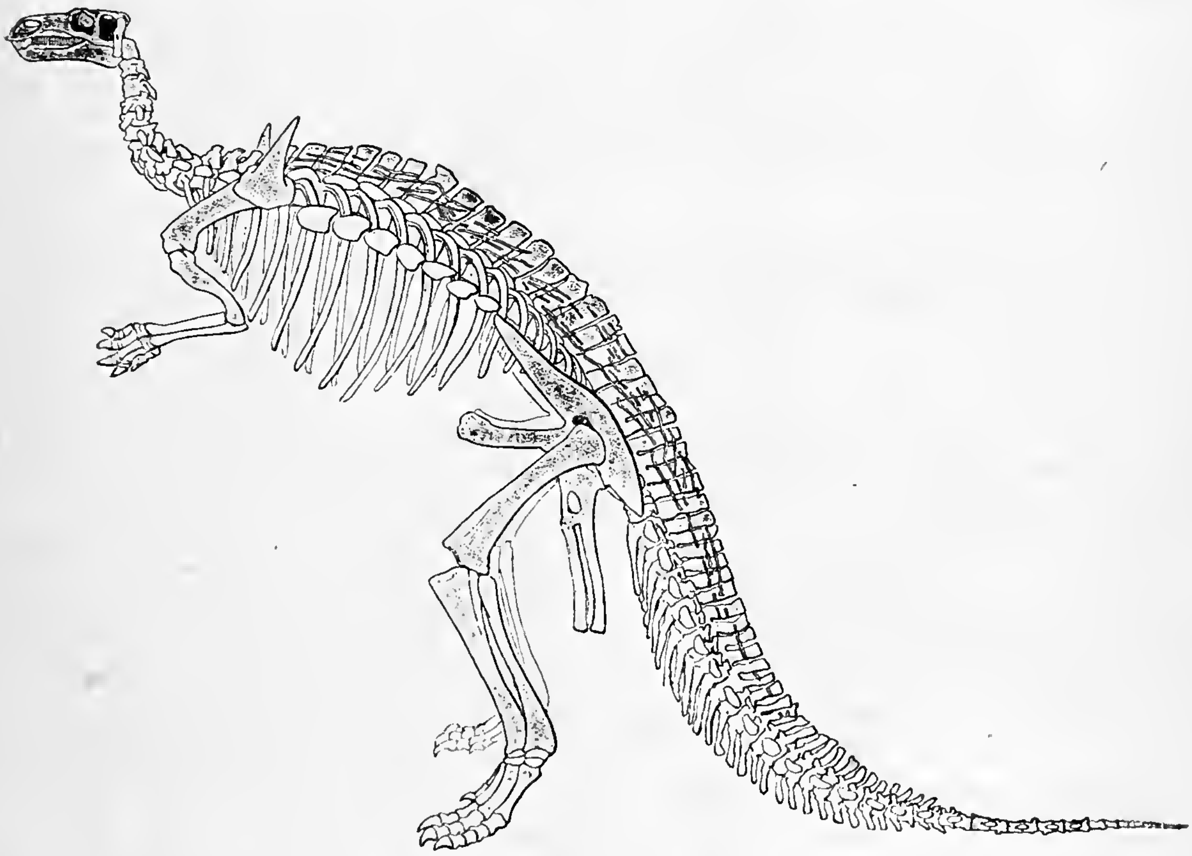


FIG. 22.— Restored skeleton of *Scelidosaurus Harrisoni* (Owen), greatly reduced, from the Lower Lias of Charmouth, Dorset. The figure shows the large lateral dermal spines on the shoulders, and the long lateral line of smaller spines, reaching from the pectoral region to the extremity of the tail; also the numerous ossified tendons running along the sides of the dorsal spines of the vertebræ from the shoulder to the tail. (The original specimen is about 12 feet in length.)

Acanthopholis. Table-case, No. 7.

A smaller Dinosaur, named *Acanthopholis*, found in the Lower Chalk of Dover, was also armed with spines, but only a few fragmentary remains of it are preserved in the collection.

Hylæosaurus.

The long dermal spines of *Hylæosaurus*, another armed Dinosaur from the Wealden, were arranged in a single row along the central line of the back.

Polacanthus. **Wall-case, No. 4. Table-case, No. 7.**

The *Polacanthus*, or many-spined Dinosaur, from the Wealden formation near Brixton, Isle of Wight, appears, as regards its dermal covering, to have been one of the most heavily-armed of these old dragons. Its body was protected by a series of long, laterally-compressed, and more or less acutely triangular osseous spines, and also by numerous plain and keeled scutes; whilst the pelvic region was covered by a large shield or carapace of thick bone firmly united to the vertebræ and ribs, like the carapace in a turtle. The tail was also protected by strong bony dermal scutes.

Many of the limb-bones and vertebræ of the back and tail were found associated with the spines, but no remains of the neck or head.

The bases of the spines are broad and asymmetrical, showing that they were arranged in one or more rows on either side of the central line of the back. The largest of these spines exhibited measures ten inches in breadth, and in height thirteen inches.

Hypsilophodon. **Table-cases, Nos. 9 and 10.**

We are mainly indebted to the researches of Prof. Huxley and Mr. J. W. Hulke for a knowledge of *Hypsilophodon Foxii*, a small Dinosaur from the Wealden, about 4 feet in length. The animal has four large and powerful digits to the hind foot, and a small rudimentary fifth outer toe; an extremely small fore foot (or *manus*), with four digits and a fifth rudimentary one. The sharp-pointed and curved ungual phalanges indicate that it was probably arboreal and rock-climbing in its habits. The sides of the crowns of the teeth are finely-serrated, and repeat in miniature the serrations of the crown of the teeth of *Iguanodon*. *Hypsilophodon* was destitute of any dermal armour. Remains of parts of several individuals have been met with at Brixton, in the Isle of Wight.

Small Glass-case, y.

Iguanodon Mantelli. **Wall-cases, Nos. 5 and 6, and Table-case No. 8.**

"Mantell's Iguanodon."—This is one of the largest of the great extinct land-reptiles, some of which certainly rivalled the elephant in bulk.* The femur (thigh bone) alone measured 4 to 5 feet in length. The fore-limbs were very short, so that it is almost certain that it did not make use of them constantly for progression on the ground, but could readily raise itself into an upright position, the weight of its body being counter-balanced by its long and ponderous tail, although it was far too bulky to progress by leaping, after the manner of a kangaroo. The slab in the centre of Case 6 contains a great portion of the

* As many as twenty-four of these huge Iguanodons were recently obtained from the Wealden of Belgium, and three or four almost complete skeletons have been put together in the Brussels Museum, proving that they were more than 30 feet in length.

skeleton of a young individual of *Iguanodon Mantelli* from Bensted's Kentish Rag quarry at Maidstone, in which the disproportion of the fore and hind limb is well shown. It will be seen that the bones of the arm and fore-arm (humerus, and radius and ulna) are barely half the length of the thigh and

Wall-cases, Nos. 5 and 6. Table-case, No. 8.

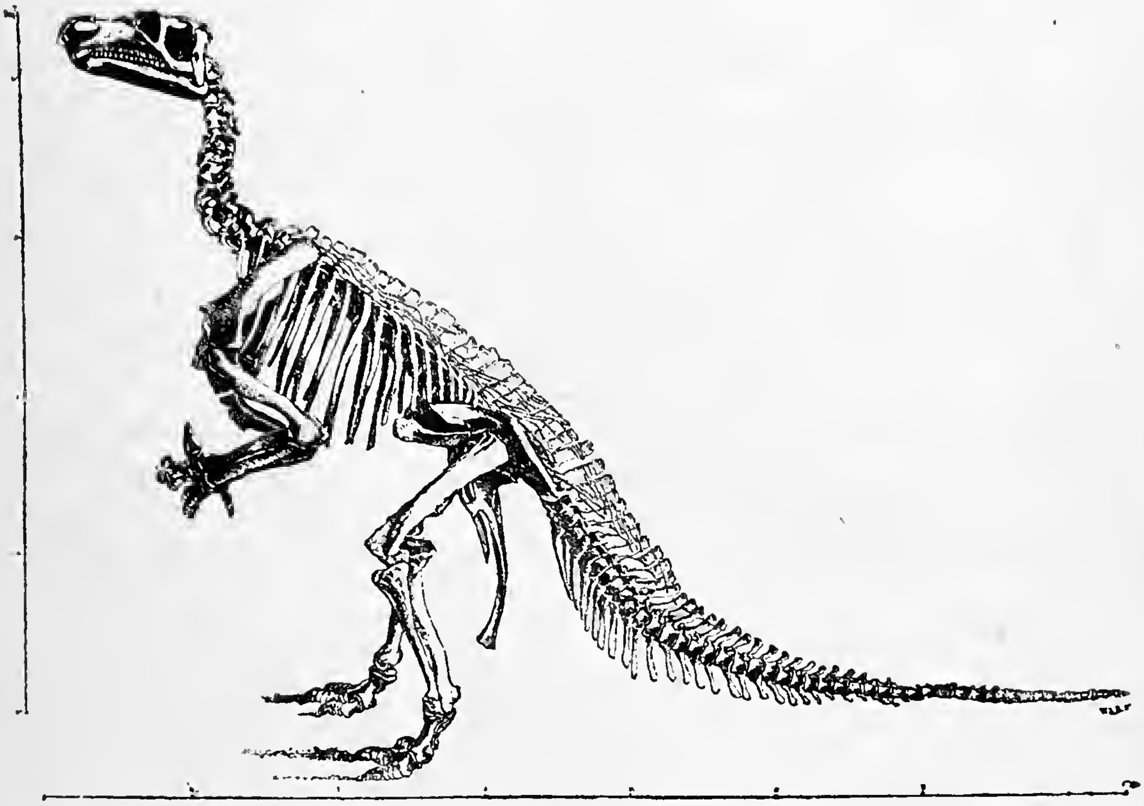


FIG. 23.—Restored skeleton, greatly reduced, of *Iguanodon Bernissartensis* (Boulenger): from the Wealden of Bernissart, Belgium (scale about $\frac{1}{75}$ nat. size). The original preserved in the Royal Museum of Natural History, Brussels.

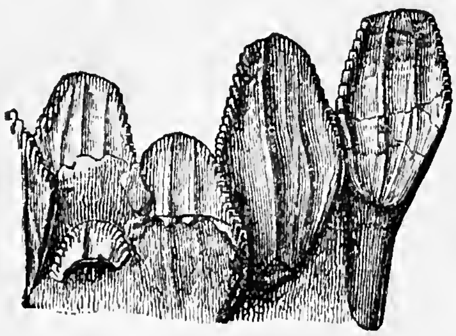


FIG. 24.—Outer view of four lower teeth of *Iguanodon* in fragment of jaw, showing unworn condition of teeth. From the Wealden of the Isle of Wight.

shin bone (femur and tibia). This difference between the leg and arm seems to have been a marked feature in a large number of Dinosaurs, as may be well seen in *Hypsilophodon*, *Compsognathus*, and many others.

The restored skeletons of *Iguanodon* exhibited in the Brussels Museum also show this disproportion very clearly (*see* Fig. 23).

Iguanodon. Wall-cases, Nos. 5 and 6.

The *Iguanodon* was vegetarian in its diet, as is proved by its teeth, which correspond with those of the living and vegetable-feeding *Iguana* of S. America.

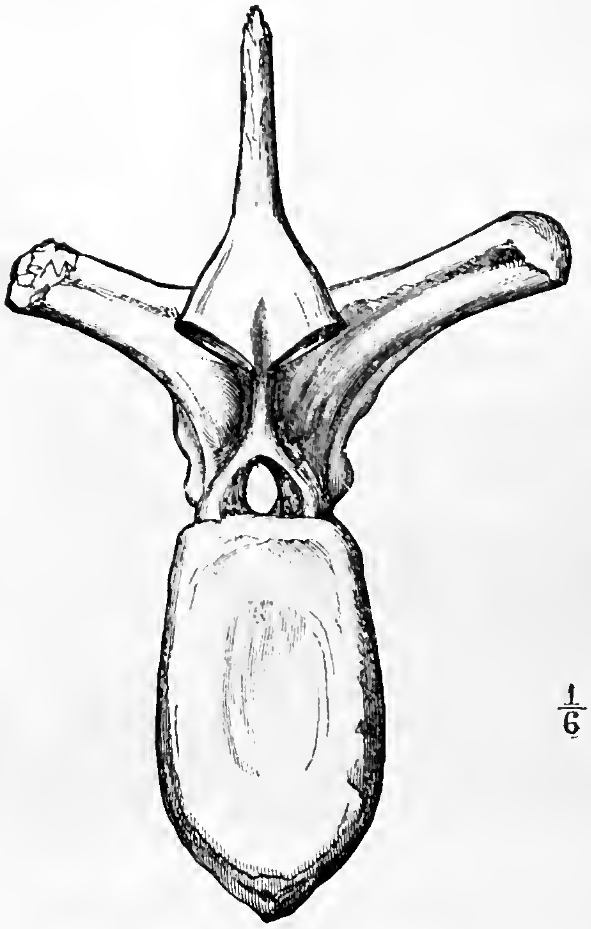


FIG. 25.—*Iguanodon Bernissartensis* (Boulenger). Posterior view of a dorsal vertebra; Wealden, Isle of Wight.

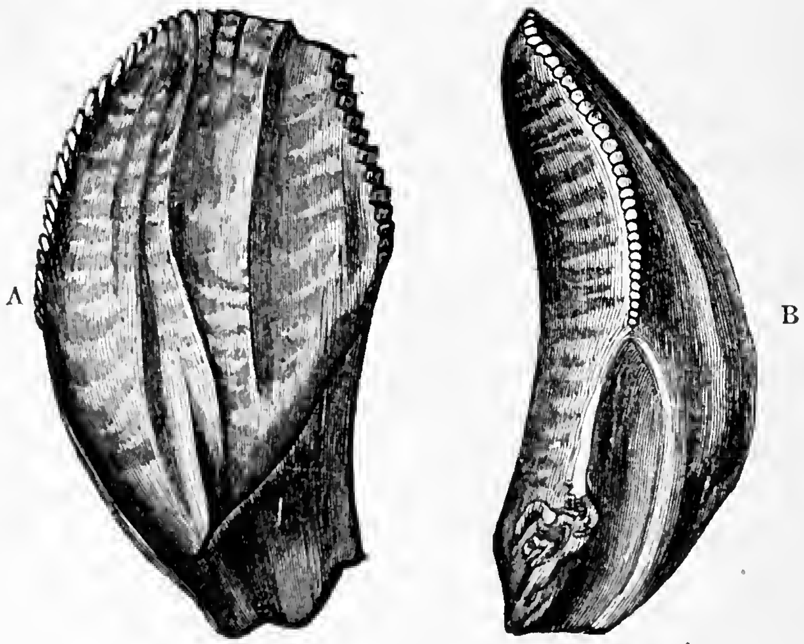


FIG. 26.—(A), Outer view; (B), Profile of Tooth of *Iguanodon* (natural size), Wealden, Isle of Wight.

Their teeth are not unfrequently found worn down at the crown, like the molar teeth of the herbivorous mammalia at the

present day. They were implanted in partially distinct sockets, and a succession of teeth always growing up from beneath replaced the worn-down stumps. The teeth are curved and leaf-shaped, and the edges are elegantly serrated, a character peculiar to all the vegetable-feeding Dinosaurs, such as *Acanthopholis*, *Scelidosaurus*, &c. (*see* Woodcut, Figs. 24, and 26). **Table-case, No. 8.**

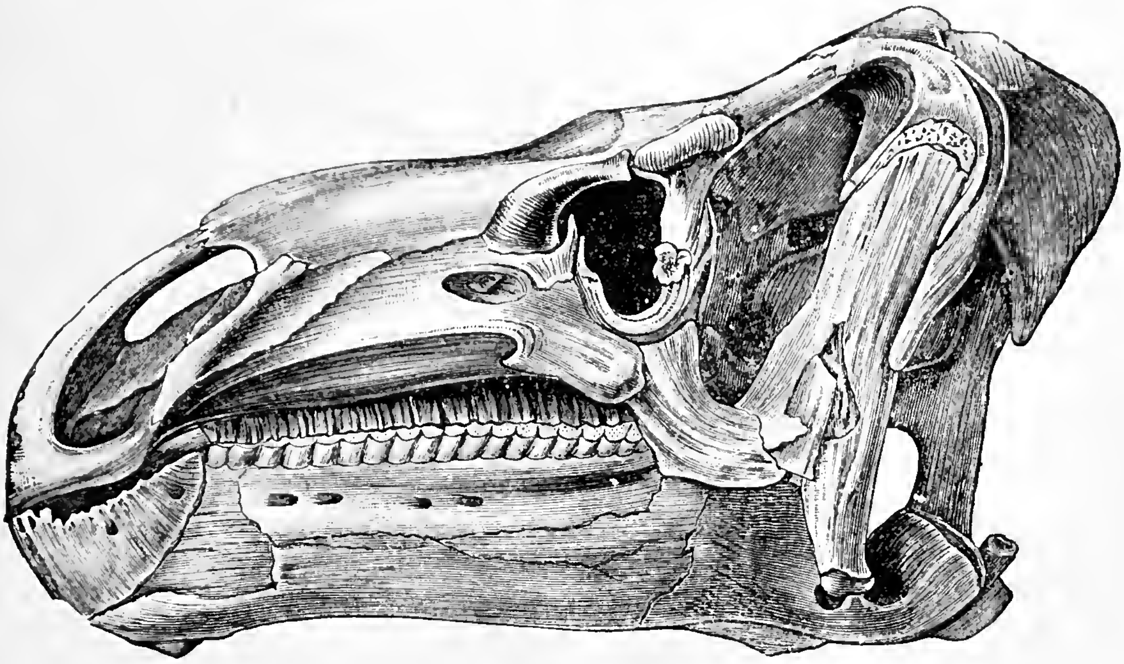


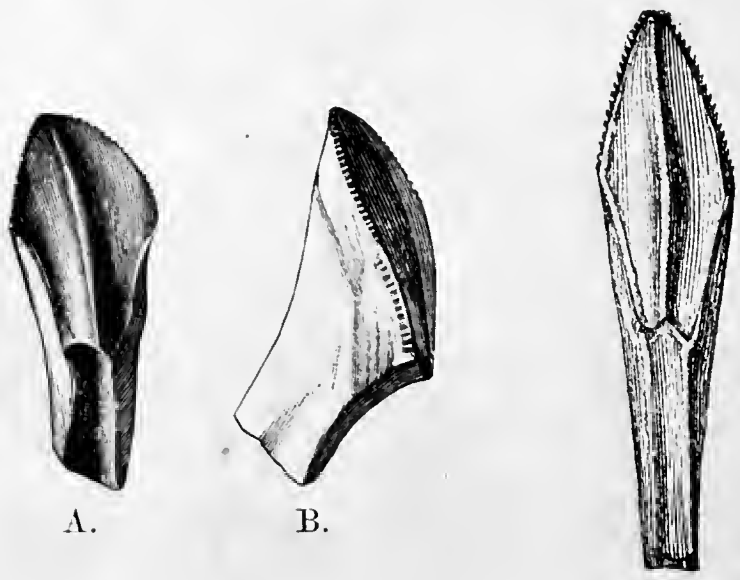
FIG. 27.—Left lateral aspect of skull of *Iguanodon Bernissartensis* (Boulenger); from the Wealden of Bernissart, Belgium (much reduced). The anterior aperture in the skull is the nares (nostril), the middle one the orbit, and the large posterior one, the infra-temporal fossa. The predentary bone is seen at the extremity of the mandible (after Dollo).

The genus *Orthomerus* (Seeley), an Iguanodont and a species of *Megalosaurus*, from the Upper Chalk of Maestricht, appear, as far as yet known, to be the most recent, and probably the last representatives in Europe in geological time of the great group of terrestrial Dinosaurs. Both species are founded upon a few long bones of limbs in the collection, and assuming them to have belonged to fully adult animals, their small proportions, when compared with those of their predecessors, probably indicates degeneration in an expiring race. **Table-case, No. 9.**

In the genus *Trachodon*, of Leidy, all the dorsal vertebræ are opisthocœlous (hollow behind), with low arches, on which the rib-facet rises to the summit of the neural platform; the centra are moderately compressed and wedge-shaped, with a hæmal carina. The teeth are simpler than in *Iguanodon*, with lozenge-shaped crowns, the inferior surface of the root of each tooth being grooved for the reception of the summit of the tooth below. In *T. cantabrigiensis* the crowns of the teeth are relatively broader than in *T. Foulki*, from New Jersey (*see* Figures 28, A, B, C).

Echinodon. Table-case,

The following are of uncertain affinities, namely:—*Echinodon*, which was a large saurian probably of aquatic habits. The teeth were flat, broadly pointed, and the upper edges strongly serrated, hence the name "prickly-tooth." A more formidable saurian



A. B. C.

Fig. 28.—(A) lateral, and (B) profile views of a tooth of *Trachodon cantabrigiensis* (Lydekker), Greensand, Cambridge; (C), tooth of *Trachodon Foulki* (Leidy), Upper Cretaceous of New Jersey, U.S.A.

Nuthetes

from the same deposit is the *Nuthetes destructor*. The teeth are flat, recurved, and finely serrated on their anterior and posterior margins, like miniature teeth of *Megalosaurus*, which they resemble.

Order IV.—SQUAMATA (Scale-covered Reptiles).

This order is largely represented by forms living at the present day, as it includes the true Lizards, the Chamæleons, and the Serpents, and in the Cretaceous epoch by the great extinct Mosasaurians. In this order the body may be either short, with well developed limbs and a distinct tail, as in the Lizards; or it may be extremely elongated without any external trace of limbs, and passing gradually into the tail, as in the Snakes. As a rule, the whole body and limbs are covered with overlapping horny scales, and these may be underlain by an armour of bony dermal scutes. The limbs may be adapted for walking on land, or modified into paddles for swimming. In the skull the proximal end of the quadrate bone is more or less movably articulated; the lower temporal arcade is wanting; the post-orbital is generally fused with the post-frontal; the palate is more or less open, the pterygoids being nearly always separated by an interval from one another, and the premaxillæ are frequently united. The vertebræ are generally procœlous

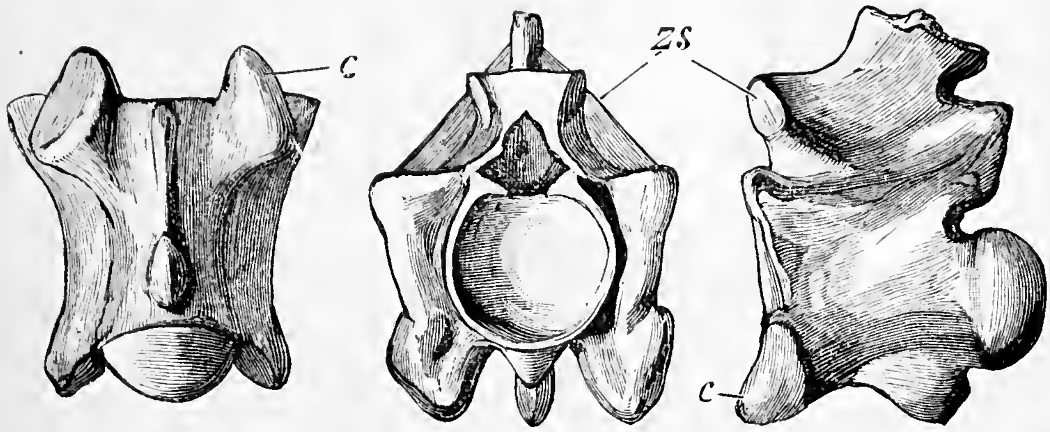
(concave in front), although more rarely they are amphicœlous (bi-concave). True abdominal ribs are never developed. The carpus has but a single centrale, and the precoracoid process is often well marked.

Sub-order 1.—**Ophidia** (Serpents).

Serpents. Table-case, No. 11.

Palæophis.

Serpents are rarely met with in a fossil state, but a few such remains have been obtained from the Tertiary rocks. The earliest Ophidian* represented in the Collection is the *Palæophis*



A B C

Fig. 29.—Vertebræ of *Palæophis typhæus* (Owen), from the Lower Eocene, Sheppey. A, hæmal; B, anterior; and C, left lateral views of a trunk vertebra, wanting most of the neural spine; *zs*, zygosphene; *c*, costal articulation.

toliapicus, a serpent about 12 feet in length, obtained from the London Clay of Sheppey; from the Middle Eocene of Bracklesham we have a still larger form, the *Palæophis typhæus*, a boa-constrictor-like snake, considered to be marine, that attained a length of 20 feet, and also a smaller species, *P. porcatus*.

A B C

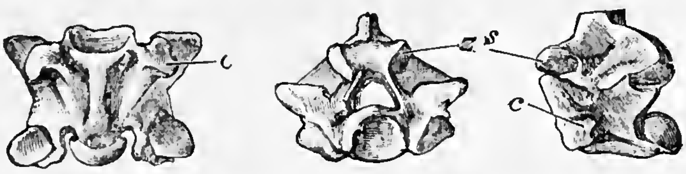


Fig. 30.—(A) Hæmal, (B) Anterior, (C) left lateral views of a trunk-vertebra of *Paleryx rhombifer* (Owen), from the Eocene Phosphorites of Caylux, France. *c*, costal articulation; *z*, *s*, zygosphene.

Paleryx.

The Upper Eocene sands of Hordwell have yielded numerous vertebræ of snakes, but of a much smaller size, namely, *Paleryx rhombifer* and *P. depressus*. Others are recorded from the Miocene of Œningen and the Lignites of Bonn-on-the-Rhine, and are exhibited in this case.

Sub-order 2.—**Lacertilia** (Lizards).

Lizards. Table-case, No. 12.

The earliest known member of the large group of existing Lacertian reptiles is *Macellodus* (with which *Saurillus* is probably identical, or closely allied), mostly known by jaws and teeth

* M. Sauvage has described Ophidian Vertebræ from the Chalk of France.

Table-case, No. 12.

from the Purbeck beds of Swanage, Dorset, a small lizard with pleurodont dentition, dermal scutes, and procœlous vertebræ.

The genus *Adriosaurus* is from the Lower Greensand of Austria; there is also a fossil lizard as large as a Monitor from the Cambridge Greensand, of unknown affinities.*

Coniasaurus, with expanded teeth, occurs in the Chalk of Kent and Sussex. Several genera of lizards are represented in the Tertiaries of France and America. Remains of a species of *Iguana* occur in the Eocene Phosphorites of France, and the Middle Eocene of Hordwell, Hampshire.

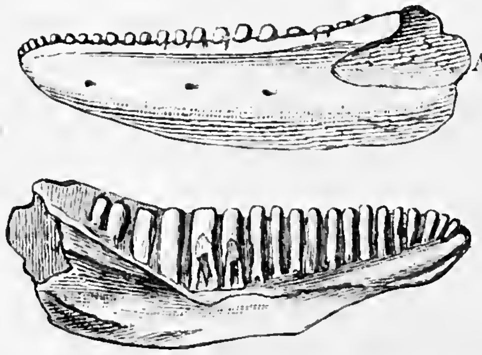


Fig. 31.—(A) Outer, and (B), inner views of the left dentary bone of an Anguoid Lizard; from the Eocene Phosphorites of Caylux, France. $\frac{1}{1}$.

The *Anguidæ* (Slow-worms) are represented by several genera from Gers in France (M. Miocene), and from Rott, near Bonn (Lr. Miocene); from Steinheim, Bavaria; and from England and North America.

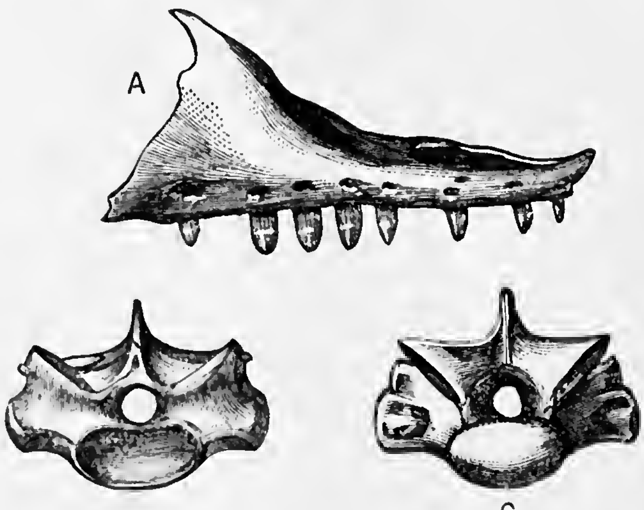


Fig. 32.—(A) Right Maxilla: (B) Anterior, and (C) Posterior views of a dorsal vertebra of *Varanus bengalensis* (Daudin), Pleistocene, Madras. $\frac{1}{1}$.

The *Varanidæ* (Monitors) are represented by a very large form, *Megalania*, from Queensland, Australia, and by *Varanus sivalensis* from the Siwalik Hills of India. Fragments of jaws, vertebræ, etc., referred to *Varanus bengalensis*, from caves, Karnul, Madras, are preserved in the collection. Similar specimens have been described by Mr. Lydekker (*see* Palæontologia Indica).

* Not represented in the Collection.

From the Chalk of Sussex and Kent have been obtained several examples of the snake-like lizard *Dolichosaurus longicollis*. **Dolichosaurus. Table-case, No. 12.**

The Pleurosauridæ are typically represented by *Pleurosaurus*, of the Lithographic stone of Bavaria, which is a medium-sized Lizard characterized by the extreme elongation of the body (in which there are a great number of presacral vertebræ), and the skull is long and narrow, with slit-like nares. *Anguisaurus* and *Acrosaurus*, of the same deposits, belong to this family, but it is not certain that they are really distinct from the type genus.

Sub-order 3.—**Pythonomorpha.**

The *Mosasauridæ* were carnivorous marine reptiles, frequently of great size, and ranging in time from the Upper Greensand to the uppermost Cretaceous beds, and having a **Wall-case, No. 8, and Table-case, No. 11.**

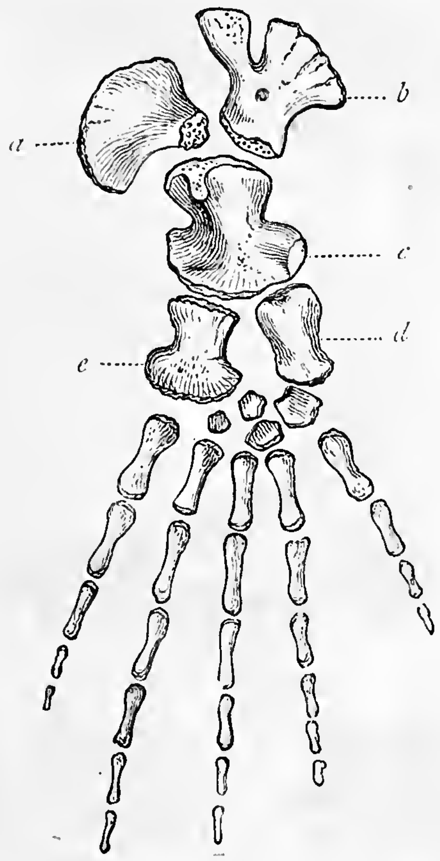


Fig. 33.—Right pectoral limb of a Mosasauroid reptile, *Platecarpus*, sp. Cretaceous strata of North America. $\frac{1}{12}$ nat. size (after Marsh.) *a*, scapula; *b*, coracoid; *c*, humerus; *d*, radius, and *e*, ulna.

world-wide distribution. The body was much elongated; the skull offers a strong resemblance to the *Varanidæ* amongst the lizards, and has the nasal and premaxillæ welded together; the quadrates very loosely articulated; teeth on the pterygoids as well as in the jaws, and frequently ossifications in the sclerotic of the eye. The teeth are large and sharp, and anchylosed by expanded bases to the summits of the jaws. The clavicles are always, and the interclavicles and sacrum generally, wanting.

Wall-case, No. 8. Table-case, No 11.

The limbs are modified into paddles with no claws to the terminal phalangeals and no foramen to the humerus. The majority of forms were devoid of dermal scutes.

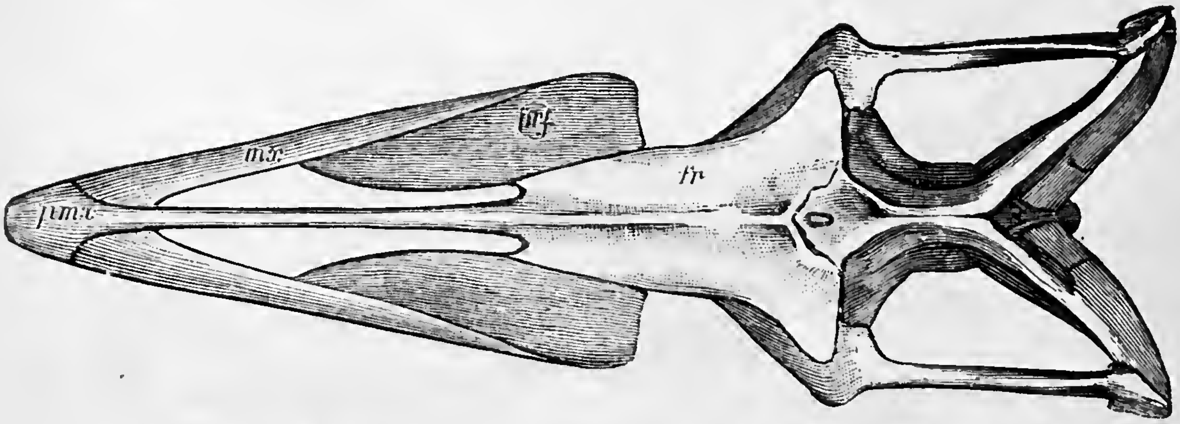


FIG. 34.—Superior aspect of the cranium of *Platecarpus curtirostris*, Cope; from the Upper Cretaceous of N. America (greatly reduced). *pmx*, premaxilla; *mx*, maxilla; *fr*, frontal; *prf*, prefrontal (after Cope).

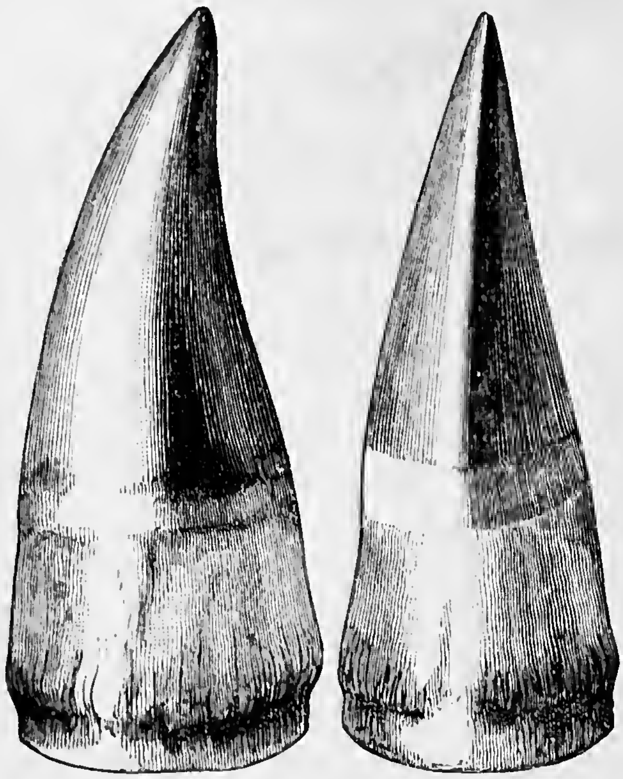


FIG. 35.—Lateral and profile views of a lower tooth of *Liodon*, sp. from the Upper Cretaceous of Mæstricht, Holland, $\frac{1}{1}$.

Mosasaurus.

These great aquatic lizard-like reptiles, known as the *Mosasaurus*, *Liodon*, etc., once inhabited the shores of the sea in which the uppermost Chalk, or Maestricht beds, were deposited, and their powerful jaws, armed with great grooved, recurved, conical teeth, their vertebræ and various other skeletal remains have been obtained from St. Peter's Mount, near Maestricht, Holland, and from the Chalk of Norfolk and Kent. Remains of over forty species have been found in the Cretaceous rocks of New Jersey, Kansas, &c., in North America. One of these, the *Mosasaurus princeps*, is computed to have been 75 to 80 feet long. In one case at least the body was covered with

small ebony plates. The paddles, which were four in number, each with five digits, had a remarkable resemblance to the "flippers" of a whale (*see* Fig. 33).

Wall-case, No. 8.

Table-case, No. 11.

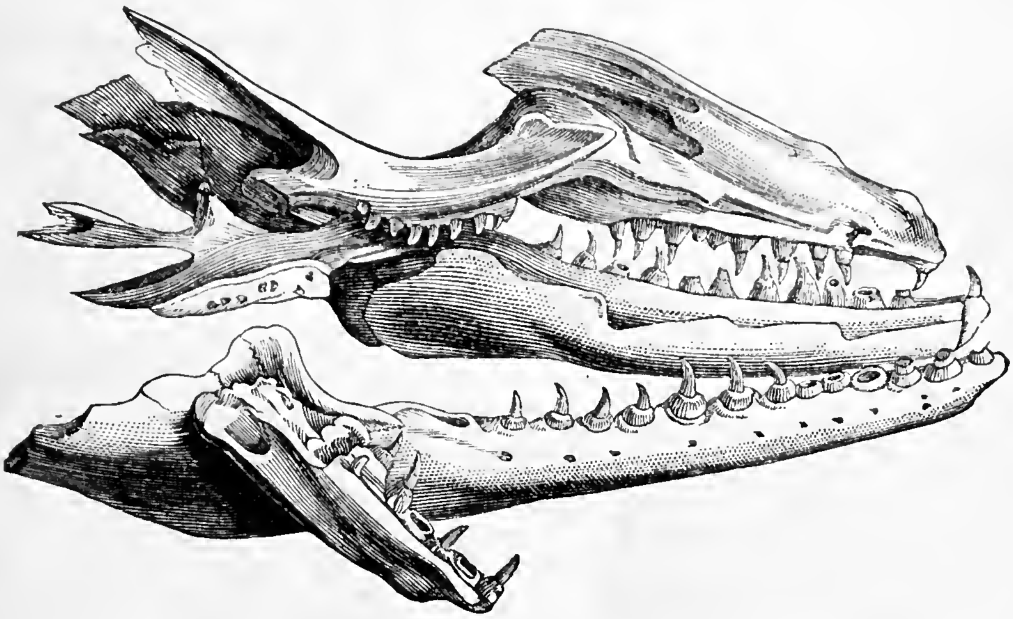


FIG. 36.—The imperfect skull of *Mosasaurus Camperi* (Meyer), from the Upper Cretaceous of Maestricht, Holland (much reduced).

Order V.—RHYNCHOCEPHALIA (Beak-headed Lizards).

Wall-case. No. 7. Table-case, No. 12.

This order has only one living representative, the genus *Sphenodon* (*Hatteria*), from New Zealand. Its earliest known ancestor, *Palæohatteria*, dates from the Permian. In external appearance the Rhynchocephalians were lizard-like animals. They have the quadrate bone of the skull immovably fixed by the proximal extremity to the pterygoid, the palate is closed anteriorly by the median union of the pterygoids; the premaxillæ are never united. The teeth are acrodont, being anchylosed to the jaws. Abdominal ribs are always present.

Rhynchosaurus.

Table-case, No. 12.

Under the name of *Rhynchosaurus articeps*, Sir Richard Owen described and figured, in 1842, a very interesting reptile from the fine-grained white Triassic sandstone of the Grinsill quarries near Shrewsbury (Trans. Cambridge Phil. Soc., vol. vii., part iii., p. 355, pl. 5 and 6).

The vertebræ are biconcave, but whilst in some characters of the processes they resemble recent lizards, in others they present characters like those of the Dinosauria.

The skull presents the form of a four-sided pyramid compressed laterally; it is also remarkable for the beak-like prolongation of the premaxillaries, which are pointed and recurved, and must have been encased in a horny sheath, like the mandible of a bird of prey.

It had also, like the still existing New Zealand lizard *Sphenodon* (*Hatteria*), to which it is closely allied, two rows of minute acrodont teeth, united to a sharp edge of the maxillary

Table-case, No. 12.

and palatine bones respectively, between which the teeth of the lower jaw fit in a longitudinal groove. This character was unknown until quite recently, when a skull in the collection, having the mandibles in natural position, was skilfully developed from the matrix, and revealed the fact. The biconcave form of the vertebræ, sternal and abdominal ribs, and general characters of the limbs, also show the near affinity of this ancient extinct land-lizard to its living representative.

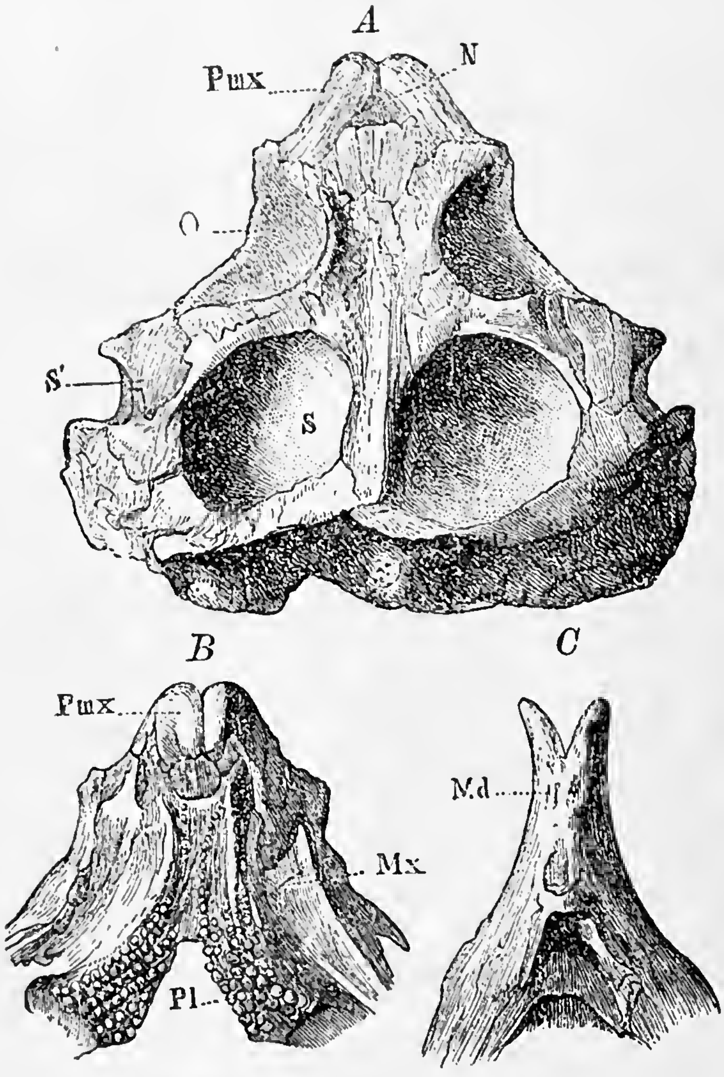


FIG. 37.—Skull of *Hyperodapedon Gordoni* (Huxley), Triassic Sandstone, Lossiemouth, Elgin, Morayshire, Scotland ($\frac{1}{4}$ nat. size). A, upper surface of skull; B, palatal aspect of skull; C, under side of front of lower jaw; *Pmx*, premaxillary bone; *Mx*, maxillary; *Pl*, palatal teeth; *Md*, mandibles; *O*, orbit. *N*, anterior nares; *S*, supratemporal fossa; *S′*, lateral temporal fossa.

Hyperodapedon. Table-case, No. 12. Wall-case, No. 7.

Another form, but of much larger proportions, named by Prof. Huxley, *Hyperodapedon*, has been obtained from the Triassic sandstone of Elgin, Morayshire, Scotland, having the same compressed broadly triangular form of skull, with the orbits directed upwards and the premaxillaries prolonged into a sharp recurved beak, like *Rhynchosaurus*, which must have been encased in a similar horny sheath.

The dentition is very peculiar, for, unlike *Rhynchosaurus*, the maxillary and palatine bones were provided with several

rows of well-developed low conical teeth closely set, and so arranged posteriorly as to form a deep longitudinal groove between two or more rows of teeth on each side for the reception of the marginal teeth of the mandible; these teeth are small and closely arranged, and wear by attrition with the upper teeth into a sharp cutting edge. There is also present on the inner side of the mandible a series of large and obtuse teeth. **Wall case, No. 7. Table-case, No. 12.**

The fine specimen of *Hyperodapedon Gordoni* exhibited from Elgin shows the head, neck, and body region, and some of the limb-bones in fair preservation, but the whole of the caudal region is absent. It was a terrestrial reptile, and attained a length of six or seven feet, and does not appear to have been armed with scutes or spines, but there are traces of wrinkled (skin) markings on the slab near the vertebræ.

A much larger species, named *Hyperodapedon Huxleyi*, has been obtained from the Triassic deposits of Maleri, India, of which a good series of the jaws is exhibited. It is computed to have attained a length of 17 ft.

Prof. Huxley remarks ("Quart. Journ." Geol. Soc., vol. xliii., 1887) that this order had already attained its greatest degree of specialization as early as the Trias; *Hyperodapedon* being in all respects a more modified form than *Sphenodon*. It appears therefore to be probable that in the Permian, or perhaps still earlier, there must have existed Lizards differing less from the existing genus than either *Hyperodapedon* or *Rhynchosaurus*.

Aphelosaurus, from the Permian, France, is also placed here.

From the Trias of Elgin in Scotland, we have the very small Lacertian, the *Leptopleurus* (*Telerpeton*), not exceeding seven inches in length. **Table-case, No. 12.**

The *Saurosternon* is another small form of Triassic lizard, from the reptiliferous sandstones of South Africa.

From deposits of Oolitic age we have the *Homœosaurus*, *Sapheosaurus*, and *Ardeosaurus* from the Lithographic stone of Solenhofen.

Order VI.—PROTEROSAURIA.

To this order is referred a reptile named *Proterosaurus Speneri*, from the Permian "Copper-slates" of Thuringia. Though capable of progression on land, it was evidently of aquatic habits, feeding upon the *Palæoniscidæ* and other fishes, which abounded in the seas of that period. **Proterosaurus. Table-case, No. 18.**

Order VII.—ICHTHYOSAURIA (Fish-Lizards).

These great marine carnivorous reptiles had very short necks (*see* Woodcut, Fig. 43), probably not visible at all externally; the vertebræ are numerous and deeply biconcave (*see* **Wall-case, No. 14, Table-cases, Nos. 13 and 14.**

Wall-case, No. 14.

Table-cases, Nos. 13 and 14.

Fig. 40, A). They are primarily divisible into a precaudal and a caudal series without any differentiated sacrum, the pre-

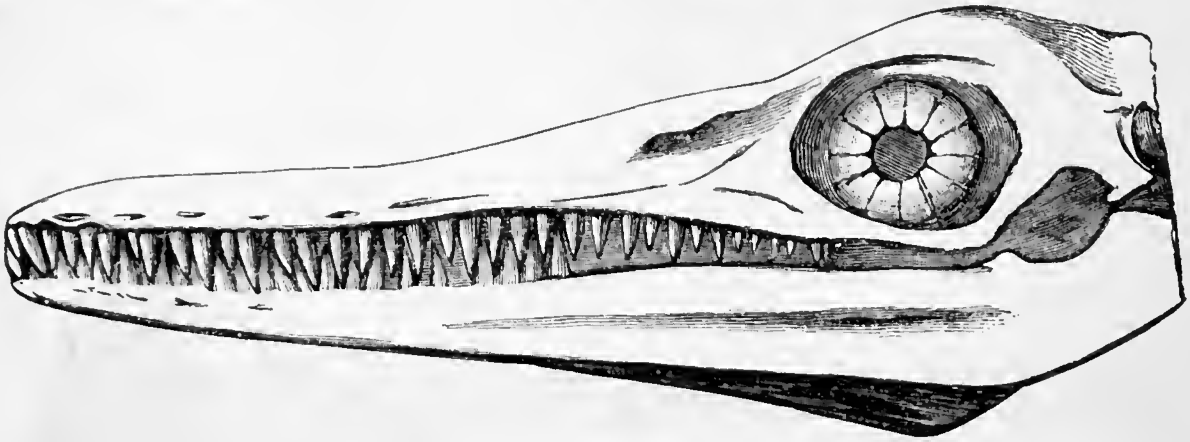


FIG. 38.—Left lateral aspect of the skull of *Ichthyosaurus communis* (Conybeare); from the Lower Lias, Lyme Regis, Dorset (about $\frac{1}{9}$ nat. size). The body was entirely devoid of any hard exo-skeleton.

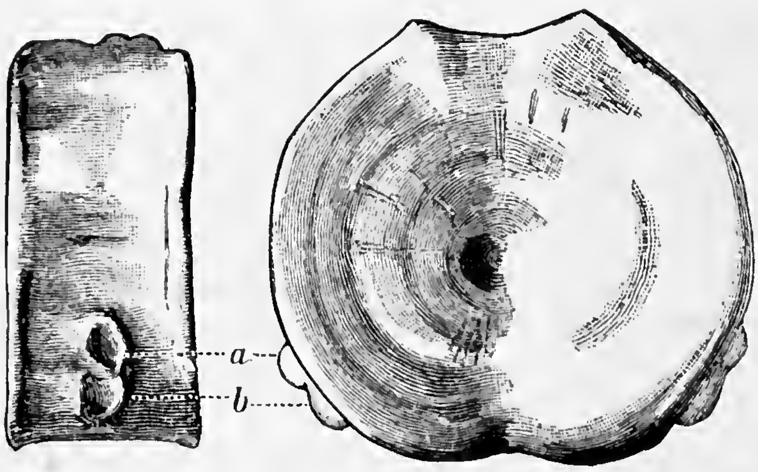


FIG. 39.—Left lateral and anterior aspects of the centrum of an early posterior dorsal vertebra of *Ichthyosaurus trigonus* (Owen); Kimmeridge Clay, Stanton. *a*, upper, *b*, lower costal tubercle.

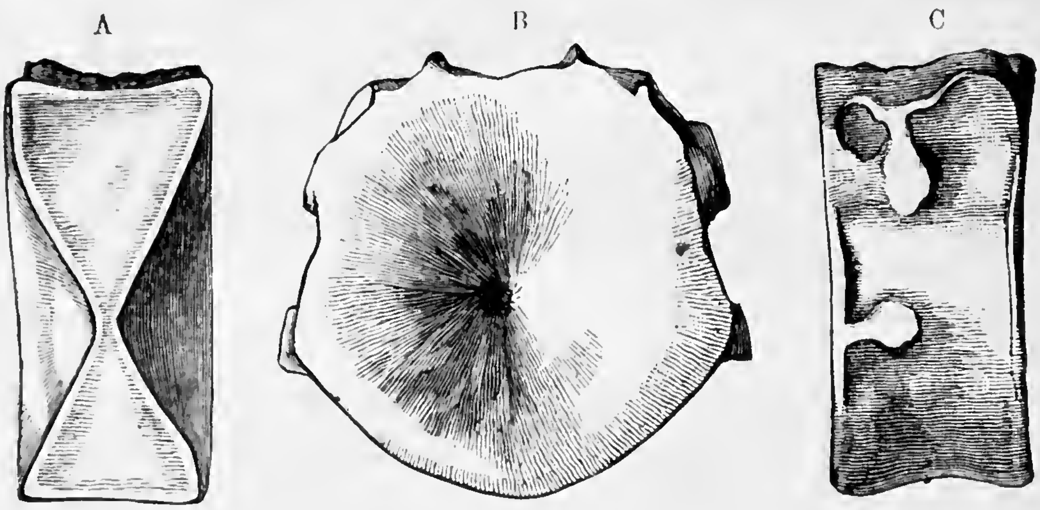


FIG. 40.—The centrum of an anterior dorsal vertebra of *Ichthyosaurus entheciodon* (Hulke), Kimmeridge Clay, Wilts. A, section; B, anterior aspect; C, left lateral aspect.

caudals have an upper and a lower costal or rib-tubercle on the centrum; the caudals have a single tubercle; the neural arches are attached by synchondrosis (by cartilage or gristle) to

the flat surfaces on the centra. Intercentra are present between the skull and atlas, and between the atlas and axis. The dorsal ribs are double-headed. Ribs are present in the caudal region; the chevrons are not united below. Abdominal ribs are present, but there is no sternum. There are clavicles and a T-shaped interclavicle present in the pectoral girdle; the coracoids do not overlap, there is no distinct precoracoid. The pelvis is

Wall-case, No. 14. Table-cases, Nos. 13, 14.

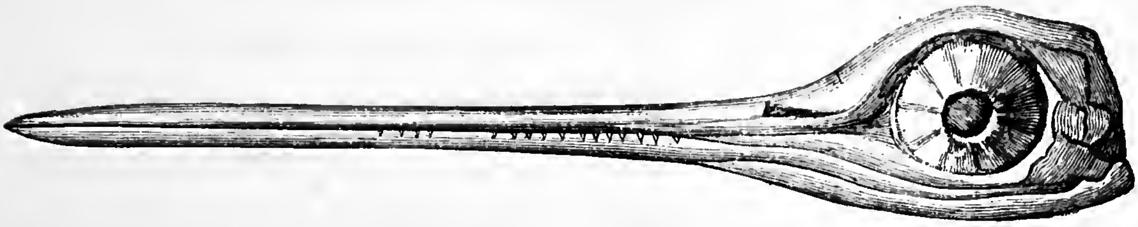


Fig. 41.—Left lateral aspect of skull of *Ichthyosaurus latifrons* (König), from the Lower Lias of Barrow-on-Soar, Leicestershire, $\frac{1}{8}$ nat. size.

weak, the iliac bones are not connected with the vertebræ, there is an open obturator notch. The skull had very large orbits, and the eyes were surrounded by a ring of broad bony (sclerotic) plates. The jaws were elongated, and armed with powerful teeth implanted in grooves. The hand and foot are modified into fin-like organs, composed of short polygonal bones, arranged in five closely approximated rows, with supernumerary rows of marginal ossicles added (*see* Figs. 45 and 46).

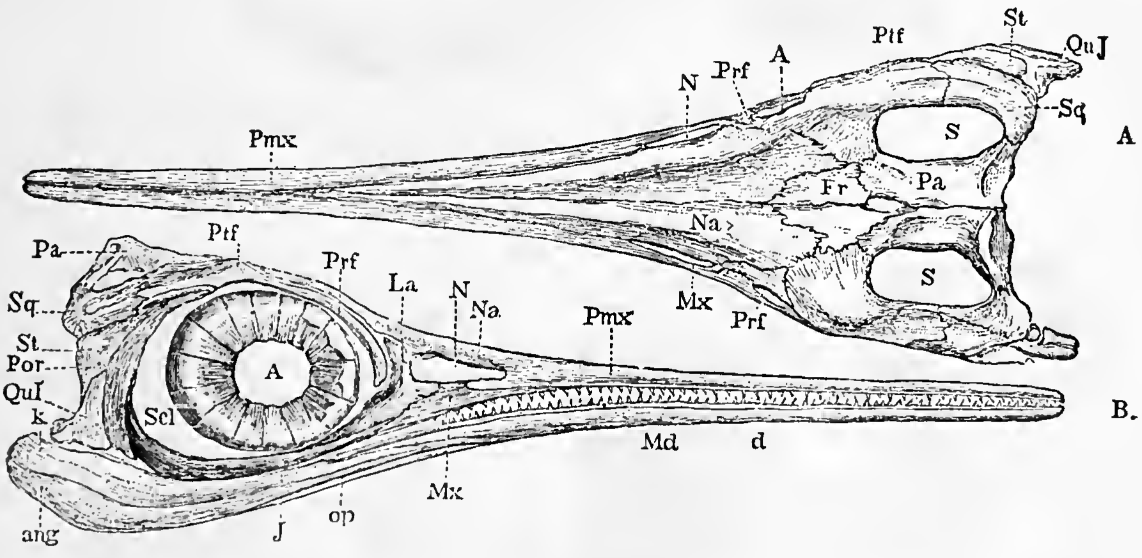


Fig. 42.—A, superior, and B, right lateral aspect of the skull of *Ichthyosaurus zetlandicus* (Seeley) from the Upper Lias of Normandy (reduced). *Pmx*, premaxilla; *Mx*, maxilla; *N*, nares; *Na*, nasal; *Fr*, frontal; *Prf*, prefrontal; *Ptf*, postfrontal; *Pa*, parietal; *J*, jugal; *QuJ* quadratojugal; *Sq*, squamosal; *St*, supratemporal; *Por*, postorbital; *A*, orbit; *B*, supratemporal fossa; *Scl*, sclerotic; *Md*, mandible; *d*, dentary; *op*, splenial; *ang*, angular; *k*, articular (after Zittel).

The largest entire *Ichthyosaurus* is from Lyme Regis, and measures 22 feet in length and 8 feet across the expanded paddles; but detached heads and parts of skeletons prove that they often attained a far larger size than this.

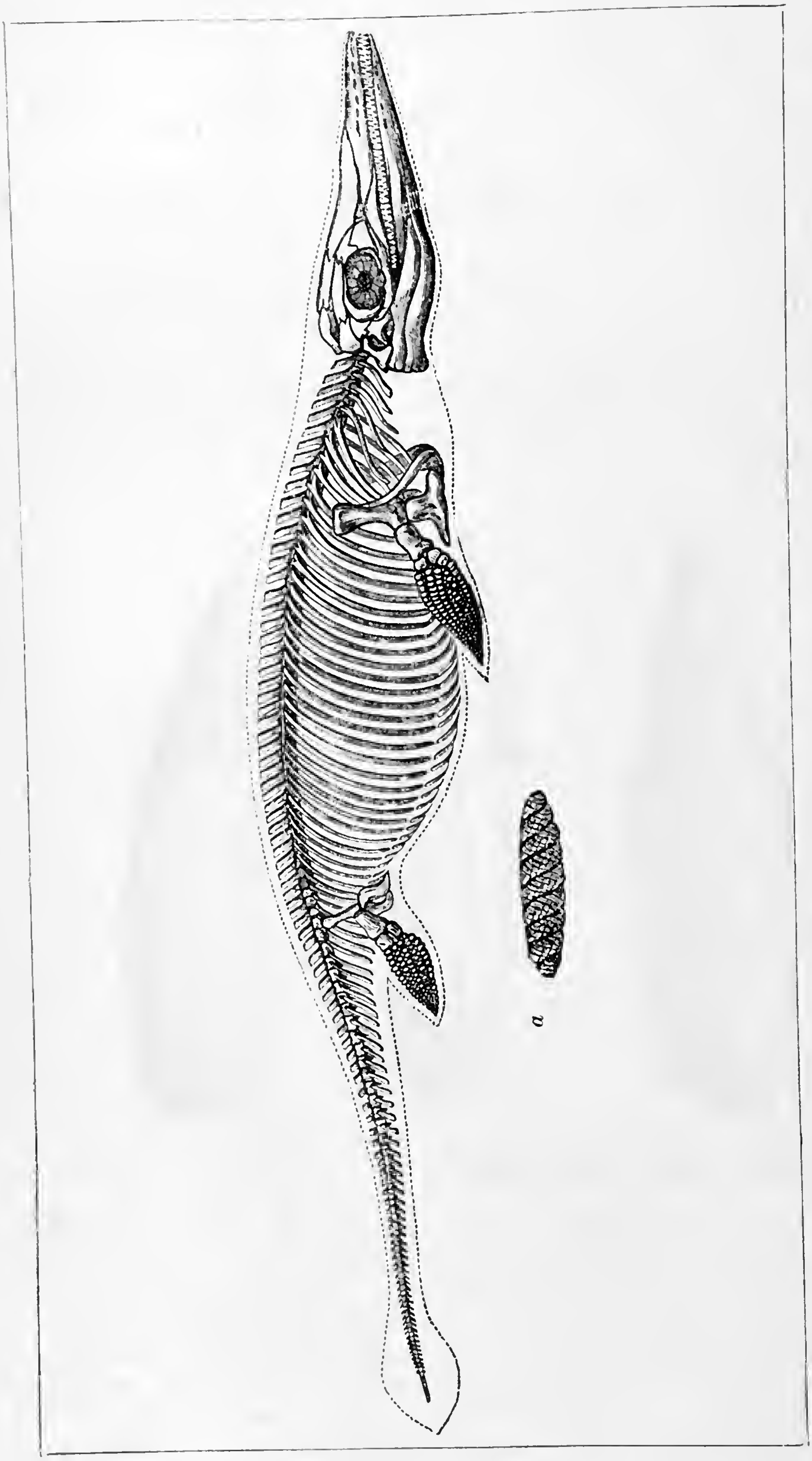


FIG. 43.—Skeleton of the Short-necked Marine Fish-Lizard (*Ichthyosaurus*), from the Lias of Lyme Regis, Dorset. *a* represents one of the coprolites of these saurians.

In some of the Ichthyosaurs the jaws are prolonged into a long and slender rostrum; others have short and robust heads, and jaws armed with large teeth. A most perfect example of the long and slender-jawed form of *Ichthyosaurus tenuirostris*, from the Lower Lias of Street, Somerset, was presented in 1884, by Alfred Gillett, Esq., of Street, Somerset.

Gallery, No. 11. Wall-case, No. 13.

Two other genera slightly modified from *Ichthyosaurus*, namely *Baptanodon* and *Ophthalmosaurus*, are included with it here.

Table-case, No. 14.

Some diversity of opinion exists as to the homology of the three bones which articulate with the distal extremity of the humerus and femur in the two latter forms. Marsh and Hulke correlate them as in *Ichthyosaurus*, with the radius, intermedium, and ulna; Seeley terms them radius, ulna, and olecranon; whilst Baur considers that they represent the radius, ulna, and pisiform.

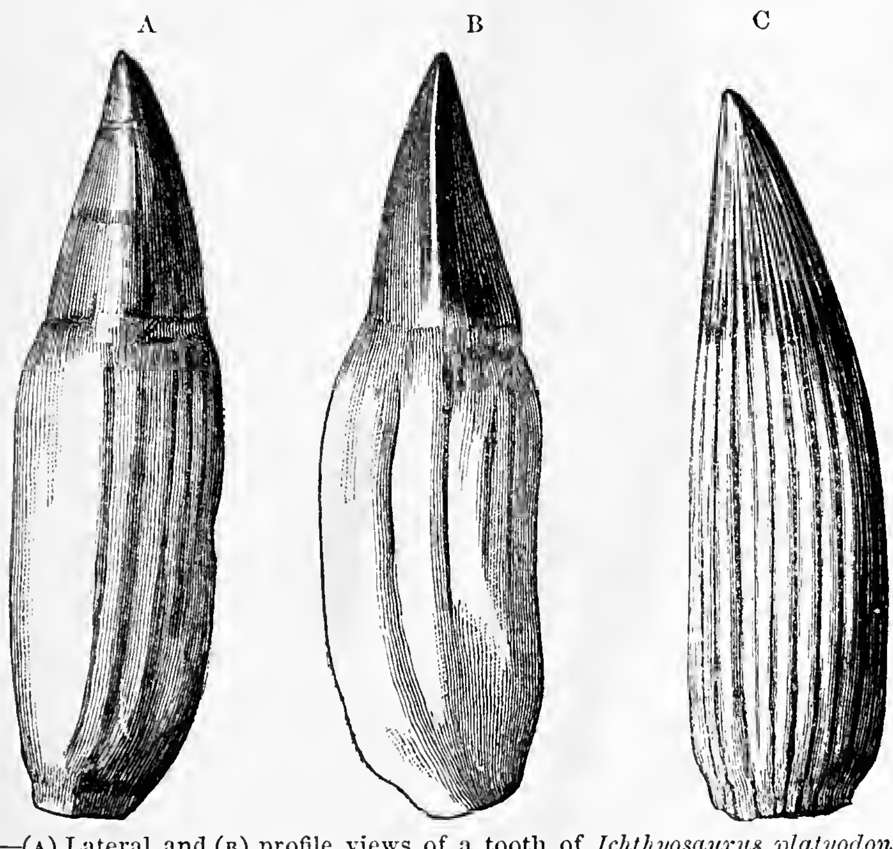


Fig. 44.—(A) Lateral and (B) profile views of a tooth of *Ichthyosaurus platyodon* (Conybeare) Lower Lias, Lyme Regis, Dorsetshire. (C) Tooth of *Ichthyosaurus communis* (Conybeare), Lower Lias, Lyme Regis, Dorset.

It has been almost certainly shown by Baur that the Ichthyopterygia have taken their origin from terrestrial or amphibious ancestors. The structure of the limb in the more generalized species of *Ichthyosaurus* indicates that the pectoral limb consists primarily of only four digits, the first digit being unrepresented, and the fourth and fifth arising in the usual manner from the ulnare. The additional rows of phalangeals in the more specialized forms it is suggested are due to a splitting up of the radial (2nd) and intermedial (3rd) digits, the presence of

Wall-case, No. 14.

Table-cases, Nos. 13, 14.

two centralia in the carpus of these higher forms is therefore an acquired and not an inherited character.

The structure of the palate is essentially the same as in *Sphenodon*. There is a remarkable resemblance between the Ichthyopterygia and the Rhynchocephalia in the structure of the pectoral arch, in the presence in both of abdominal ribs; in the similar position of the parietal foramen in the cranium, and the relation of the quadratojugal to the surrounding bones. In both there is the same absence of a lateral vacuity in the mandible.

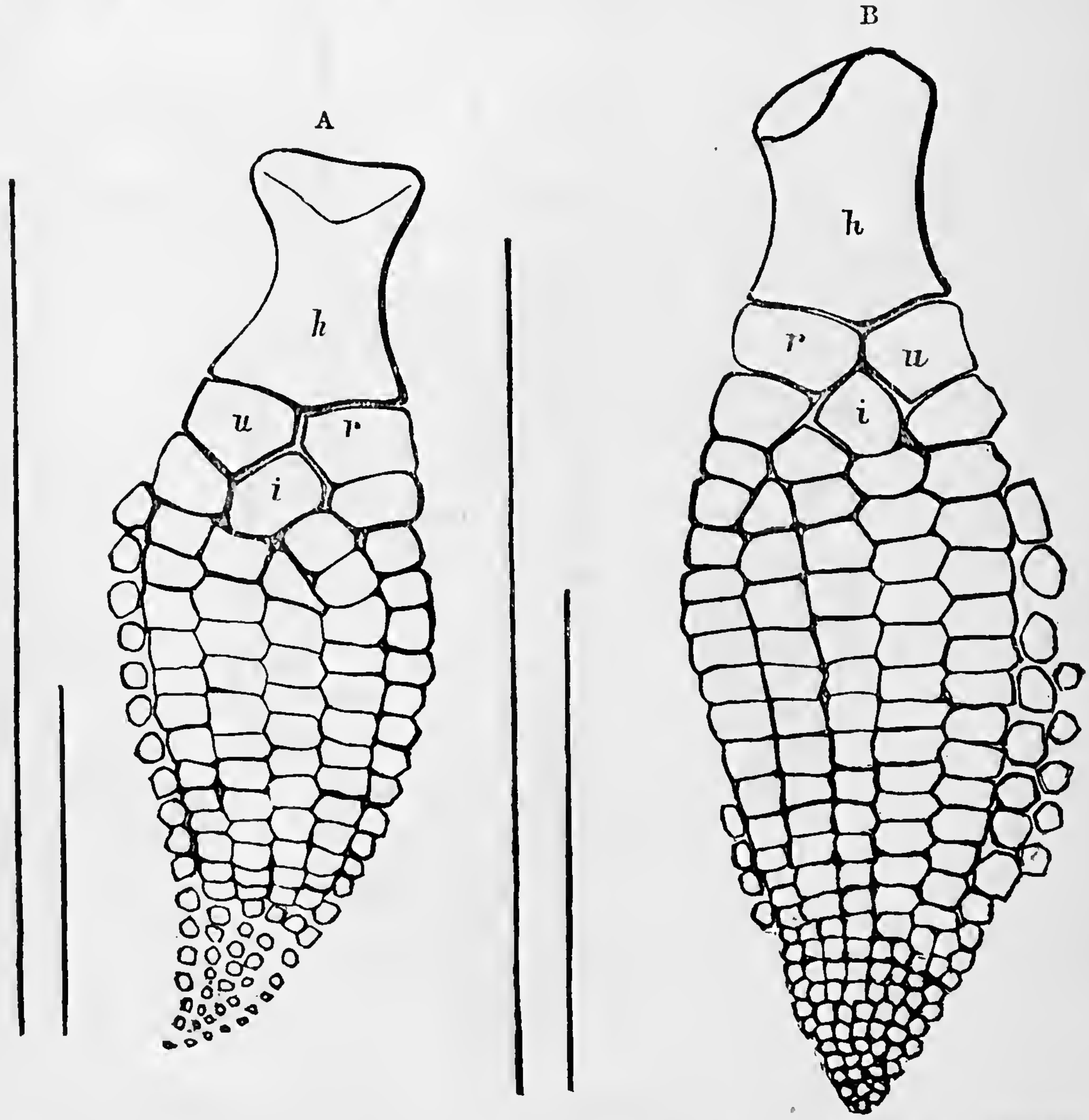


FIG. 45.—(A) Ventral aspect of the left pectoral limb of *Ichthyosaurus Conybeari*, (Lydekker), Lower Lias, Lyme Regis (½ nat. size). *h*, humerus; *r*, radius; *u*, ulna; *i*, intermedium. The vertical lines show the relative lengths of the limb and the skull, the longer line being that of the skull. The notches in the anterior border of the first row of phalangeals are omitted. (B) Dorsal aspect of the left pectoral limb of *Ichthyosaurus communis*, (Conybeare), Lower Lias, Lyme Regis. The letters and lines are the same as in Fig. A.

The teeth are confined to the jaws and are implanted in a continuous groove, without anchylosis of the bone. Their crowns are sharply pointed, and they are usually cylindrical and deeply fluted, more rarely carinated, compressed, or smooth (*see* Fig. 44 A, B, C).

The humerus and femur are relatively short, but the radius and tibia are still shorter, and may be reduced to oblong bones in which the breadth is greater than the length. The humerus has no foramen. Usually the anterior pair of (pectoral) paddles is the larger (*see* Figs. 45 A, B; and 46 A, B). The humerus and femur in this order are unique in that, instead of having convex condyles for the articulation of the fore-arm (radius and ulna) they present distinct concavities for their reception.

Wall-cases, No. 14.
Table-cases, Nos. 13, 14.

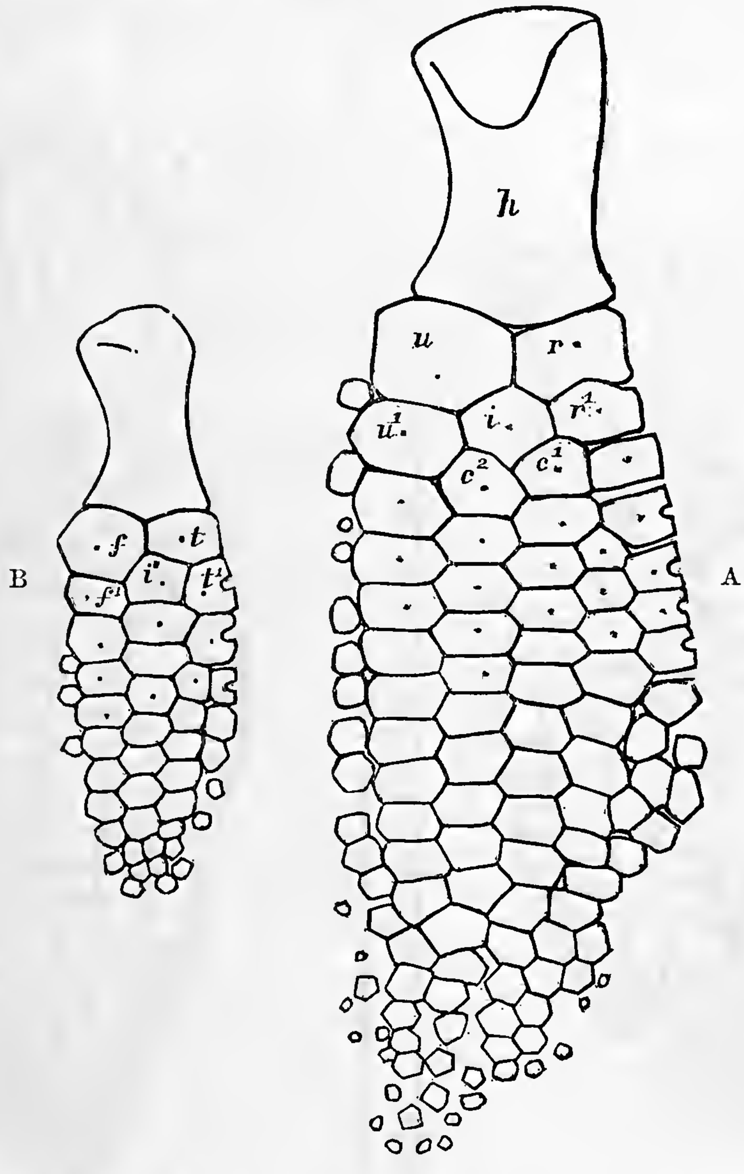


FIG. 46.—(A) Dorsal aspect of the left pectoral, and (B) ventral aspect of the right pelvic limb of *Ichthyosaurus intermedius* (Conybeare); Lower Lias, Lyme Regis, Dorsetshire. A. *h*, humerus; *r*, radius; *u*, ulna; *r* 1, radiale; *i*, intermedium; *u* 1, ulnare; *c* 1, *c* 2, centralia; B. *f*, femur; *.t*, tibia; *.f*, fibula; *t* 1, tibiale; *f* 1, fibulare; *i*, intermedium.

These old marine lizards must have exercised the same repressive action over the teeming animal population of the old Liassic seas that the sharks do in our seas at the present day. They existed during the long period of geological time represented by the several formations extending from the Upper Trias and Rhætic to the Chalk inclusive (*see* Table of Stratified Rocks, p. x.), but they occur in the greatest abundance, both as

regards individuals and species, and also in the most perfect preservation, in the Lias formation. Geographically, they enjoyed an exceedingly wide range of distribution, their remains having been discovered in the Arctic regions, in Europe, India, Ceram, North America, the East Coast of Africa, Australia, and New Zealand. Nearly entire skeletons of both young and adult animals have been obtained from beds of this age with but few of the bones displaced, as may be seen by many specimens in the Wall-case.

Order VIII.—CHELONIA (Tortoises and Turtles).

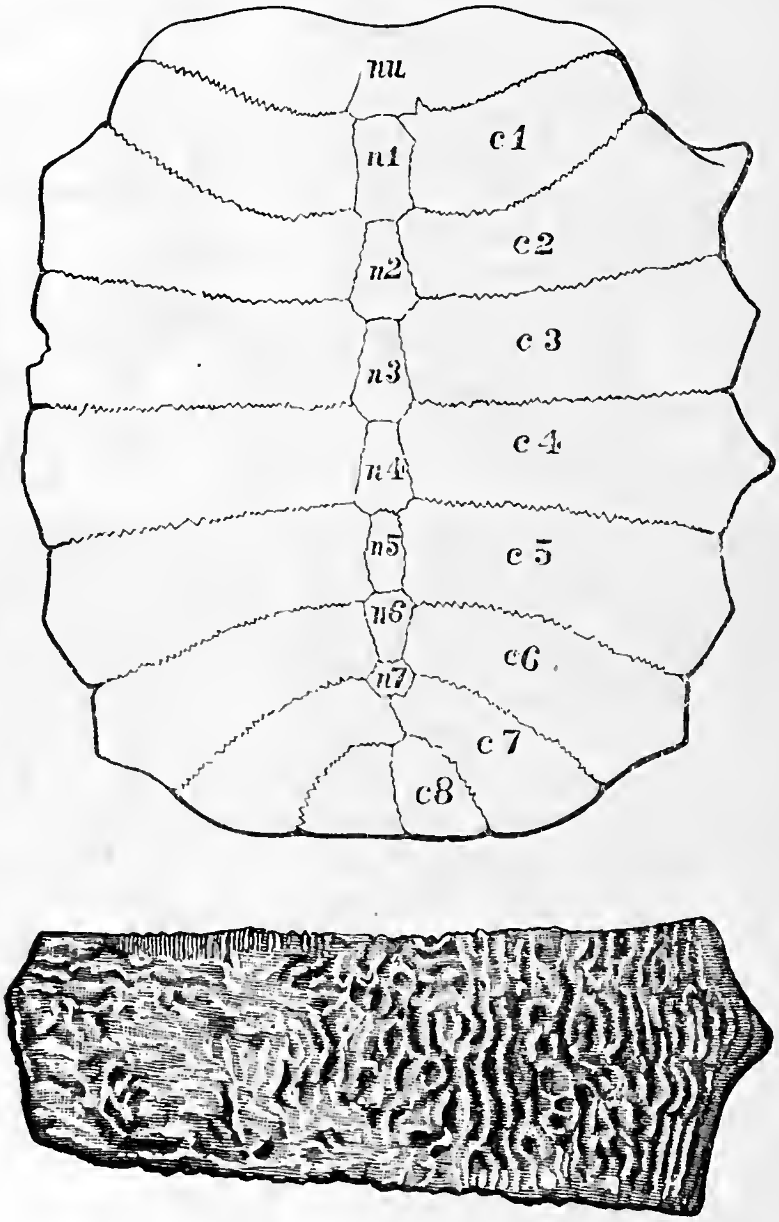
Tortoises and Turtles.

Wall-cases, Nos. 11 and 12.

Table-cases, Nos. 20, 21, 22.

The Chelonia are exhibited in two wall-cases and three table-cases placed in the West Corridor (No. 5 on Plan), which connects the Mammalian with the Reptilian Galleries.

A.



B.

Fig. 47.—a. Carapace of *Trionyx Gergensi* (Meyer), from the Lower Miocene of the Mayence Basin, $\frac{1}{4}$ nat. size; *nu*, nuchal; *c*1 to *c*8, costals; *n*1 to *n*7, neurals. **b.** The fourth right costal plate with the sculpture drawn on a larger scale.

Wall-cases, Nos. 11 & 12, and Table-cases, Nos. 20, 21, and 22.

Here are placed the fossil remains of the order CHELONIA, most largely represented at the present day, including the Tortoises and Turtles, a group of reptiles in which the vertebræ and ribs are immovable, being combined with the external coat of bony plates, closely connected by interlocking sutures,

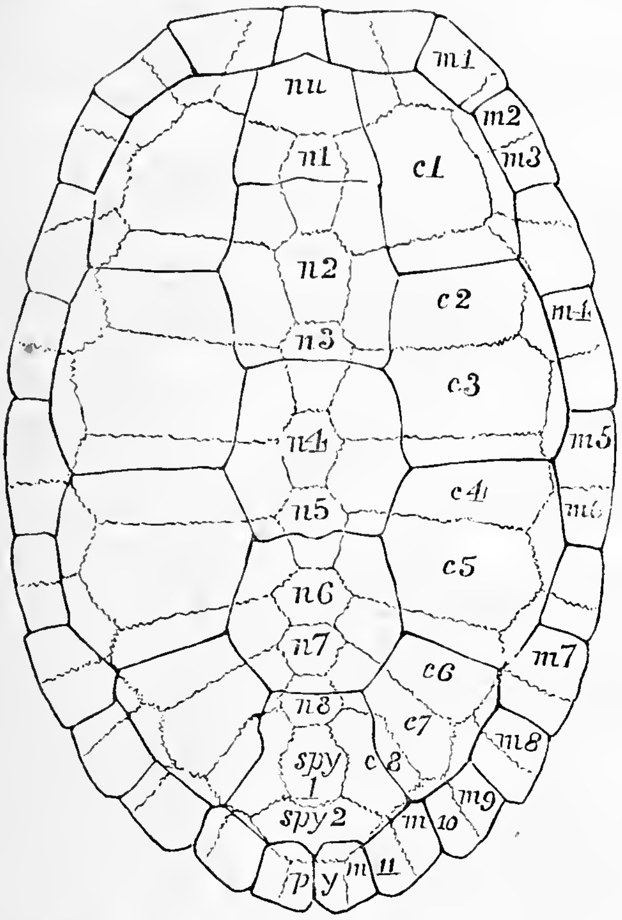


FIG. 48. — Outline of the Carapace, or dorsal shield, of *Hardella Thurgi* (Gray), reduced. *nu*, nuchal; *n*1–*n*8, neurals; *c*1–*c*8 costals; *spy*, 1 & 2, suprapygals; *py*, pygals; *m*1–*m*11, marginals. In both these figures the outlines of the bones have wavy sutures, the firm dark lines show the outlines of the overlying horny shields.

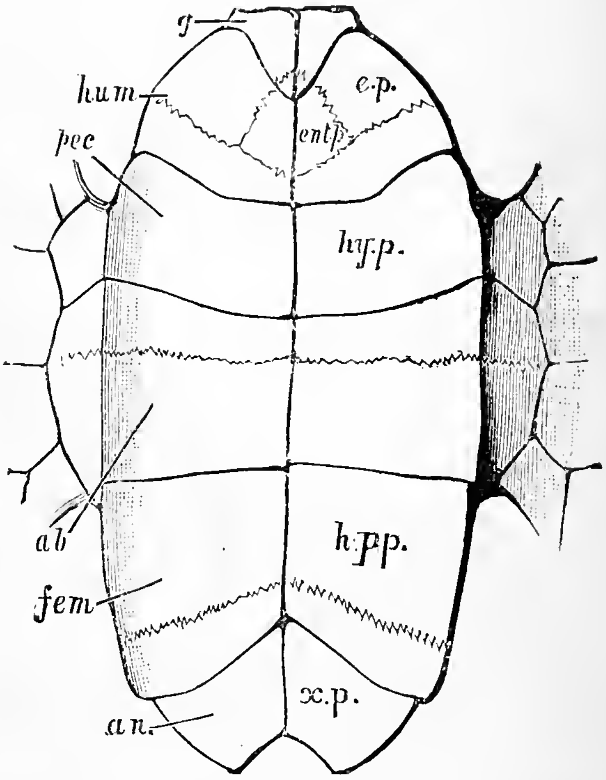


FIG. 49. — The plastron, or ventral shield, of *Cachuga tectum* (Gray), reduced; *ep.*, epiplastral bone; *entp.*, entoplastral bone; *hy.p.*, hyoplastral bone; *xp.*, xiphiplastral bone; *g*, gular shield; *hum.*, humeral; *pec.*, pectoral; *ab.*, abdominal; *fem.*, femoral; and *an.*, anal shields.

Figs. 48 and 49 are both from the Pliocene, Siwalik Hills, India.

enclosing the entire body of the animal. This box-like envelope is covered with leathery skin or horny shields; one kind of which is called "tortoise-shell," and is made into combs, &c. The bones of the skull (except the lower jaw and the hyoid bones) are also consolidated. They have no teeth, but the jaws being encased in a horny beak, the sharp edges serve instead for dividing the food.

The Chelonians are found living at the present day on land, in fresh water, and in the sea; they are all oviparous, depositing their eggs in the sand, to be hatched by the warmth of the sun. Some recent Turtles' eggs from Ascension, cemented together and fossilized in shell-sand by deposition of lime (produced through the rapid evaporation of the sea-water by the sun's heat), are exhibited in Wall-case, No. 12.

Wall-case No. 12.

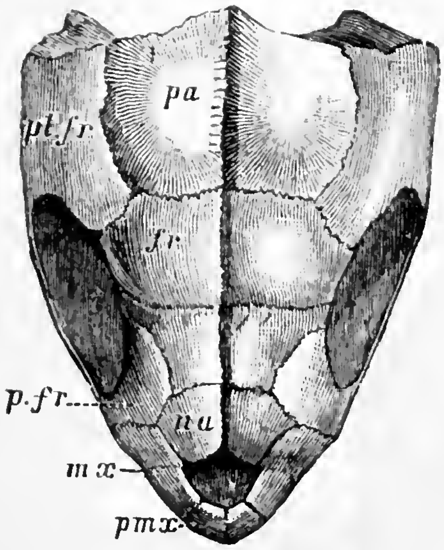


FIG. 50.—Frontal aspect of the cranium of *Rhinochelys cantabrigiensis* (Lydekker); from the Greensand, Cambridge. $\frac{1}{1}$. *pmx*, premaxilla; *mx*, maxilla; *na*, nasal; *p.fr*, prefrontal; *fr*, frontal; *pt. fr*, postfrontal; *pa*, parietal (the cranium is imperfect posteriorly).

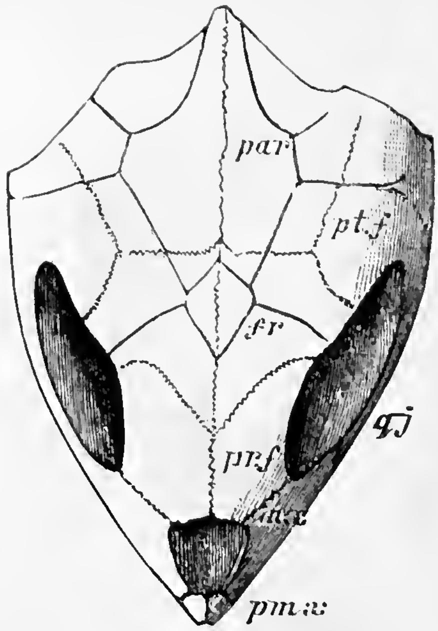


FIG. 51.—Frontal aspect of the cranium of *Argillochelys antiqua* (König); from the London Clay of Sheppey, $\frac{1}{1}$. *pmx*, premaxilla; *max*, maxilla; *qj*, quadratojugal; *prf*, prefrontal; *fr*, frontal; *ptf*, postfrontal; *par*, parietal.

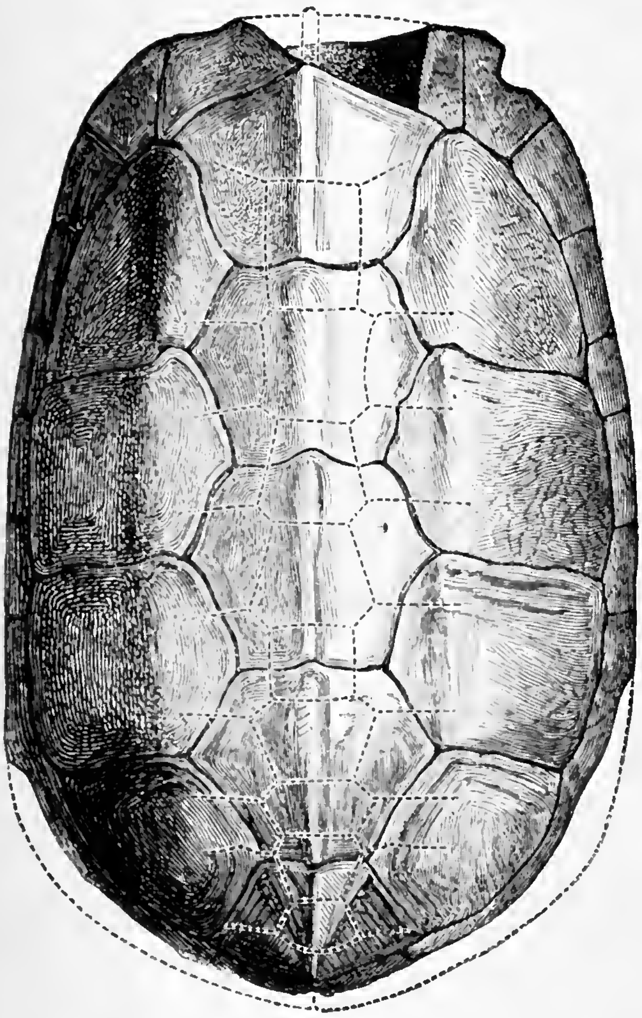


FIG. 52.—The carapace of *Nicoria tricarinata*. var. *sivalensis* (Lydekker), $\frac{1}{2}$ nat. size. Pliocene, Siwalik Hills, India. (The dotted lines indicate the bony sutures, the dark lines the horny shields.)

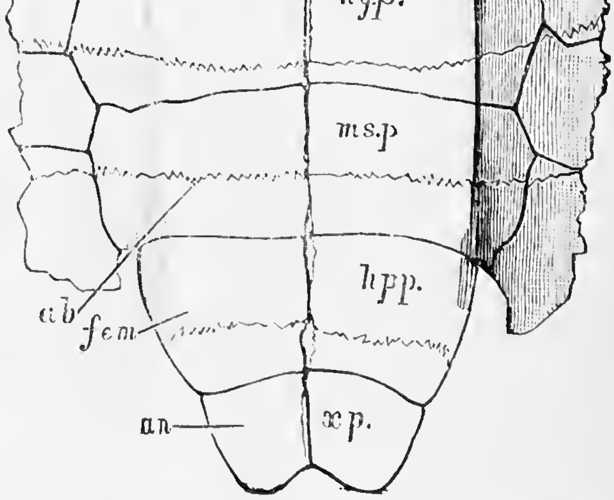


FIG. 53.—The plastron, or ventral shield, of *Pleurosternum Bullocki* (Owen), from the Purbeck beds of Swanage, Dorset. About $\frac{1}{5}$ nat. size; *ig.*, intergular shield; the rest of the letters and explanation as in Fig. 49.

TERTIARY AND SECONDARY CHELONIA.

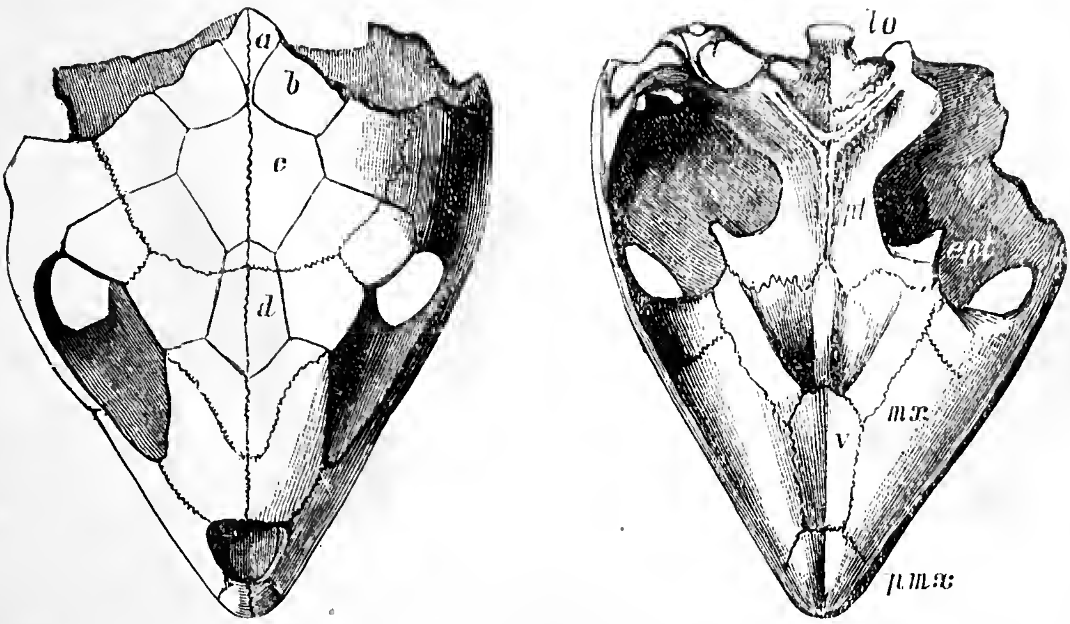


Fig. 54.—A, Frontal, and B, Palatal aspects of the cranium of a young individual of *Argillochelys cuneiceps* (Owen), from the London Clay of Sheppey. *pmx*, premaxilla; *mx*, maxilla; *pt*, pterygoid; *ept*, ectopterygoid process of the pterygoid; *bo*, basioccipital; *a*, occipital shield; *b*, paraoccipital shield; *c*, interparietal shield; *d*, frontal shield.

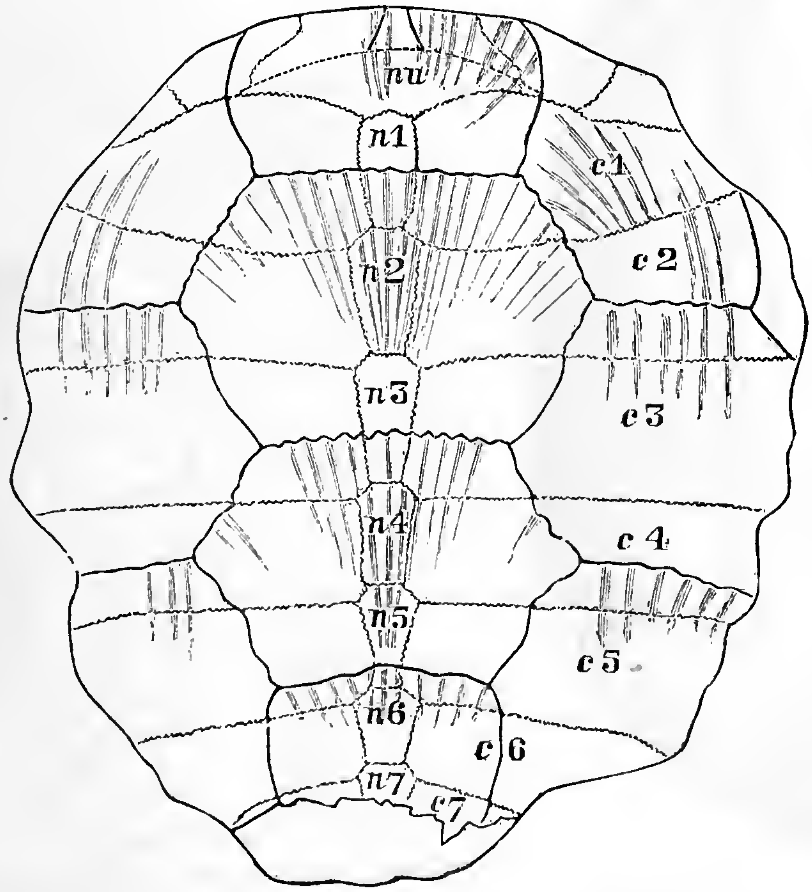


Fig. 55.—The imperfect carapace of *Plesiochelys valdensis* (Lydekker), Wealden, Isle of Wight ($\frac{1}{4}$ nat. size). *nu*, nuchal bone; *n1*–*n7*, neural bones; *c1*–*c7*, costal bones.

Tertiary and Secondary Chelonia.

The collection is particularly rich in remains of Chelonians from the Purbeck beds of Swanage, Dorset, the Chalk Gault and Greensand of England, the Maestricht beds of Holland, the Eocene Tertiaries of Harwich, Sheppey, Hampshire, the Isle of Wight, and other localities.

Table-case, No. 21.

The last surviving species of Chelonian indigenous to England was the Marsh Tortoise, *Emys orbicularis*, Linn., whose remains have been found in fluviatile deposits of Post-Pliocene age at Mundesley and East Wretham Fen, in Norfolk (*see* "Geol. Mag." 1879, p. 304) once common over a large part of Europe and still living in the South of Europe, in Asia and Algeria.

Some of the old gigantic land-tortoises (of which a few only survive) inhabited Mauritius, the Seychelles, and other islands

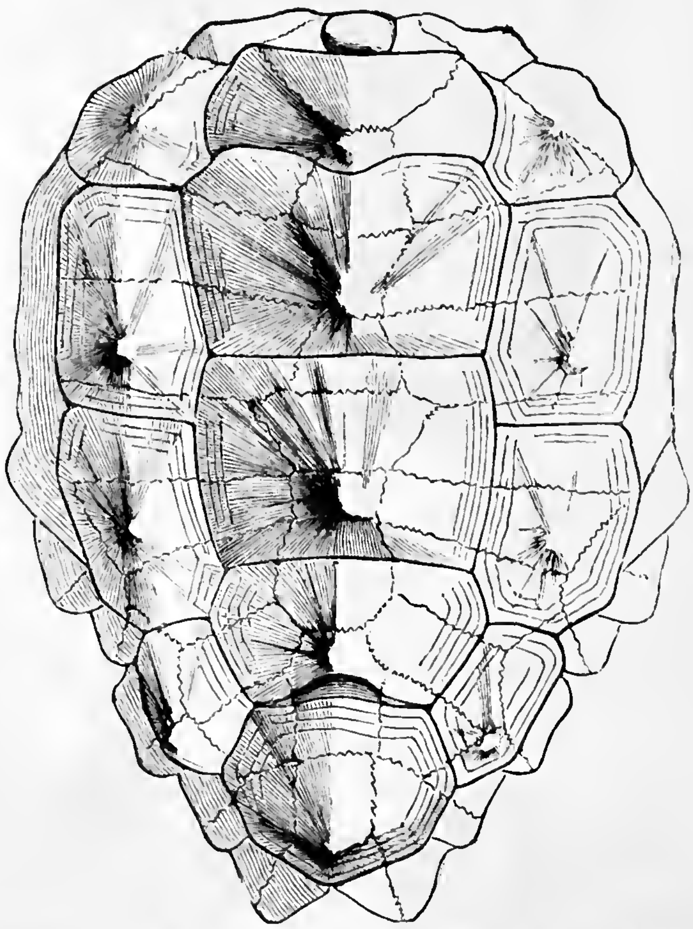


FIG. 56.—Dorsal aspect of the carapace of *Platychelys oberndorferi* (Wagner). Lithographic stone = Lr. Kimmeridgian; Kelheim, Bavaria.

of the Indian Ocean and the Galapagos Islands in the Pacific. Like the Dodo, they have been gradually exterminated by the hand of man. The largest of the fossil forms (a restored cast of which is placed on a stand at the west end of the Reptile Gallery, and marked Z, on Plan), is the *Colossochelys atlas* from the Siwalik Hills of India. The detached fragments of this great carapace are placed in the Wall-case. These old land-tortoises, so remarkable for the magnitude they attained, had extremely long necks and small heads; they were all vegetable-feeders.

Chelonia. West Corridor, No. 5 on Plan.

Wall-case, No. 11.

Several smaller species of Chelonians are also exhibited from the same Indian locality. **Wall-case, No. 11.**

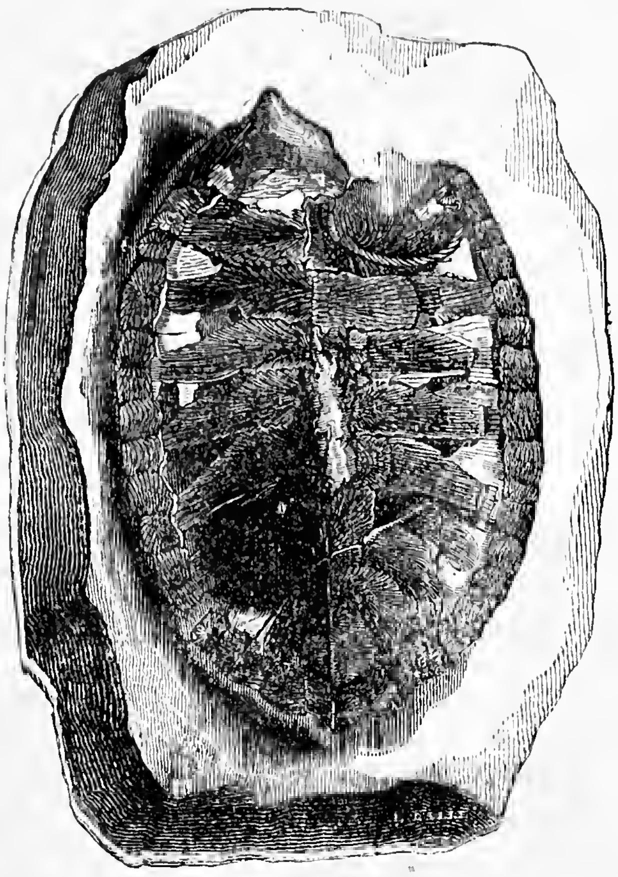


Fig. 57.—Carapace of *Chelone* (?) *Benstedi* (Mantell); Lower Chalk, Burham, Kent. (Figured in "Phil. Trans.," 1841, pls. XI and XII.)

In Wall-case 12, are placed the remains of a remarkable extinct Chelonian, named *Miolania Oweni*, A. S. Woodw., from Australia, having nine horn-like prominences on its skull, which **Wall-case, No. 12. Miolania Oweni.**

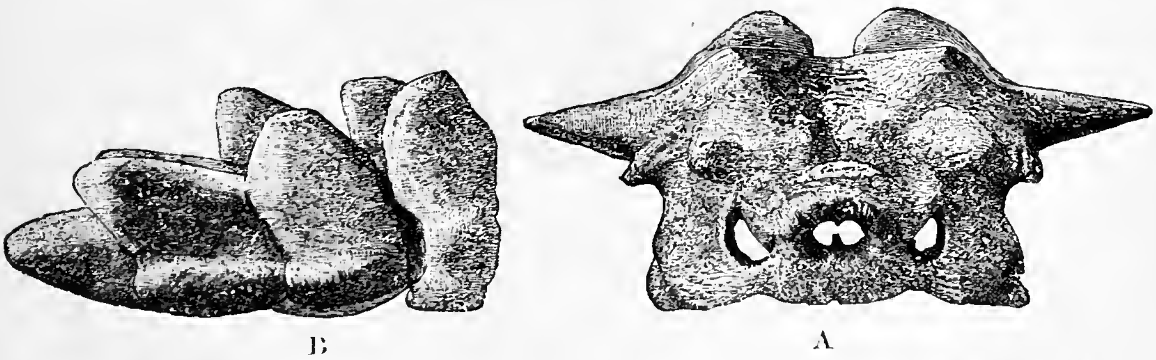


Fig. 58.—A, The Skull, and B, the Tail-sheath of the great Horned Chelonian, *Miolania Oweni* (A. S. Woodw.), from the Newer Tertiary deposits of Australia.

measured 1 foot $10\frac{1}{2}$ inches in breadth. The skull, at first glance, looks like that of some flat-headed form of Ox; but the bones are altogether dissimilar, and the jaws are without teeth.

Other remains were sent over in 1880, showing that it possessed a tail encased in a horny sheath (*see* Fig. 58, B), so like the armour-plated tail of the great extinct non-banded

Wall-case, No. 12.

Armadillo *(Glyptodon)* from South America, that had the tail arrived before the head and vertebræ had been received, it might well have been cited to prove the former existence of the *Glyptodon* in Australia (*see* "Phil. Trans." 1858, 1880, and 1881). Still further evidence of these: another species of horned Chelonians, named *Miolania platyceps* by Owen, has been obtained from a coral sandstone formation on Lord Howe Island, 700 miles from the coast of Australia, whence the first specimens were obtained.

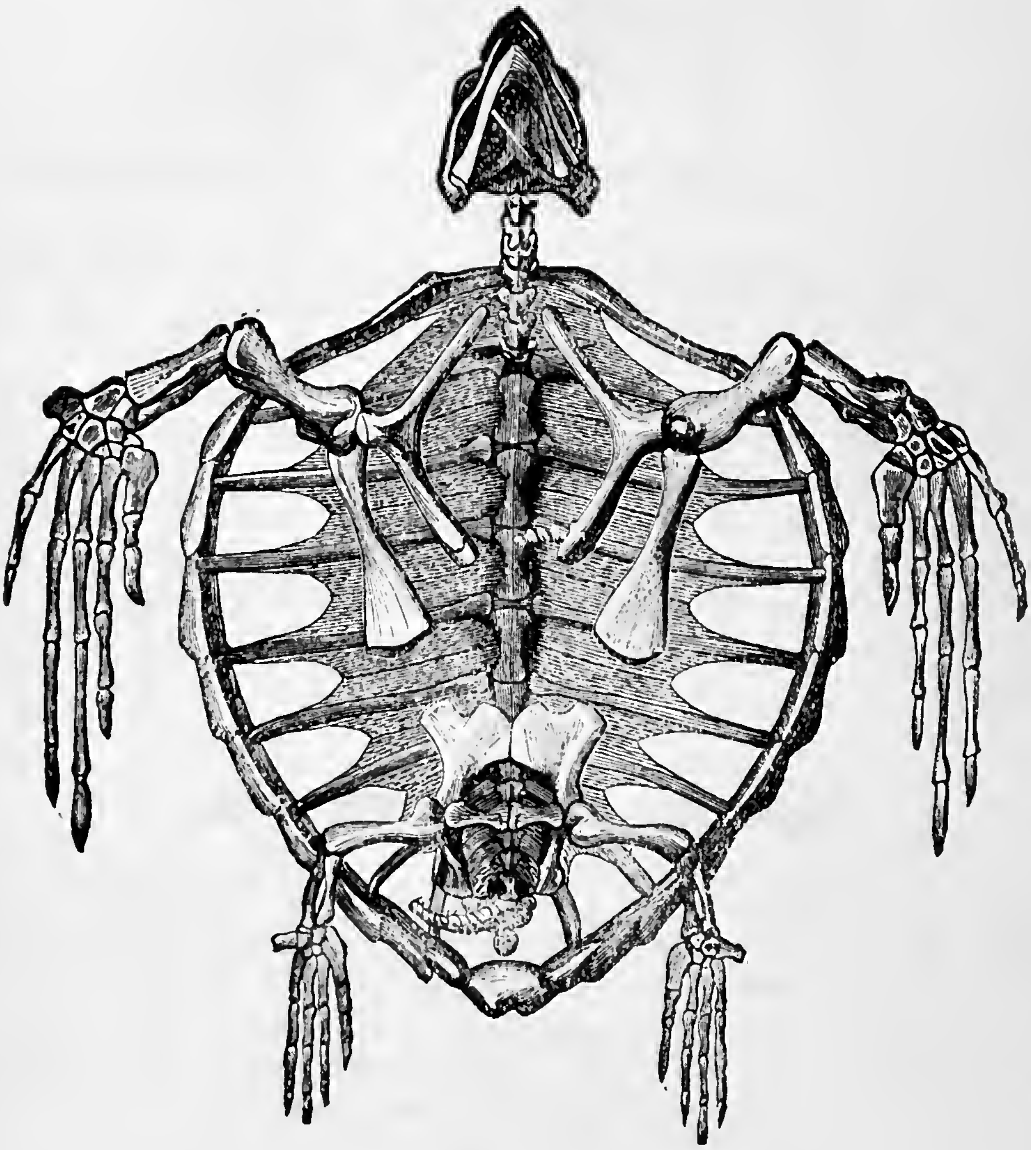


FIG. 59.—Skeleton of the Logger-head Turtle, *Thalassochelys caretta* (Linn. sp.).

This remarkable reptile was originally referred, by Sir Richard Owen, to the *Lacertilia* (Lizards), but was afterwards shown by Prof. Huxley to belong to the Chelonians, and he proposed for it the name *Ceratochelys*, from the horn-like processes on the cranium.

Chelone gigas.

Here are placed the remains of the great *Chelone Hoffmanni*, from the Chalk of Maestricht. The *Eosphargis gigas*, whose head and some other parts of the skeleton may be seen

and compared, is from the London Clay of Sheppey, and represents a still larger form related to the living Leathery Turtle. These were true marine turtles, like the "Loggerhead" Turtle of the present day (Fig. 59). **Wall-case, No. 12.**

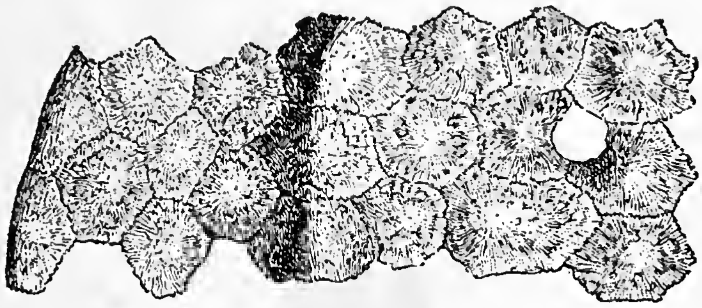


FIG. 60.—Fragment of Carapace of *Psephoderma alpinum*, Meyer; Trias, Bavaria ($\frac{1}{4}$ nat. size).

The oldest Chelonians known are the *Chelytherium obscurum*, Meyer, from the Triassic sandstones, Stuttgart; and the *Psephoderma alpinum*, Meyer, from the Lower Keuper of Hoheneck; and *P. anglicum*, Meyer, from the Rhætic of Bristol. **Table-case, No. 22.**

Of the fifty-two genera and one hundred and thirty-one species or varieties of fossil Chelonians named in the collection, only eighteen genera and ten species can be with certainty correlated with living forms; whilst for a few of the more remarkable extinct forms, such as *Miolania*, *Pelobatochelys*, and *Psephoderma*, special families have been constituted for their reception.

Order IX.—SAUROPTERYGIA.

Wall-cases, 9, 10, 13. Table-cases, 15, 16, 17.

In this extinct order the body has no exoskeleton; the neck is more or less elongated, and the tail short. In the skull the nares, or nostrils, are lateral and placed near the orbits. The premaxillæ are very large, and there is a well-developed parietal foramen in the adult. The symphysis of the mandible is united by a suture (Fig. 63). The teeth are implanted in distinct sockets and confined to the margins of the jaws; they have curved sharp crowns with fluted enamel. Each rib articulates to a single vertebra, the facets for the cervical ribs may be either single or double, and are situated entirely on the centrum. The vertebræ are amphicœlous (concave at both ends). The neck may have as many as from 21 to 40 vertebræ. A few of the vertebræ behind the cervicals have the ribs articulating partly on the arch and partly on the centrum: these have been named pectoral vertebræ. The ribs attached to the dorsal vertebræ have the articulation entirely on the arch, which generally forms an elongated transverse process. The

Wall-cases, Nos. 9, 10, 13.

Table-cases, Nos. 15, 16, 17.

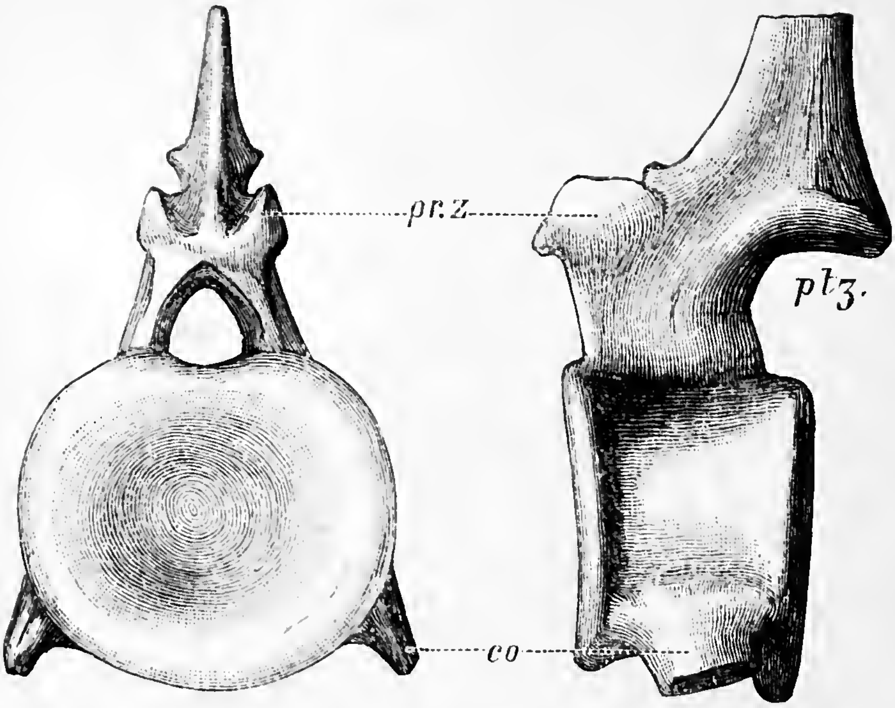


FIG. 61.—Anterior and left lateral aspects of a cervical vertebra of *Cimoliosaurus Richardsoni* (Lydekker) from the Oxford Clay, Weymouth, Dorset. ½ nat. size, *co*, rib; *prz*, prezygapophysis; *ptz*, postzygapophysis.

caudal vertebræ carry true ribs and also chevron bones. In the pectoral girdle, the coracoids unite in a ventral symphysis, and the scapulæ may also meet on the median line. The limbs

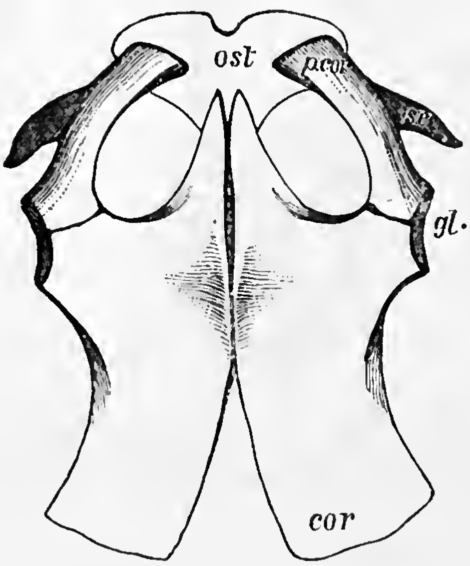


FIG. 62.—Ventral aspect of the pectoral girdle of *Plesiosaurus Hawkinsii* (Owen), from the Lower Lias, Street, Somerset (about ¼ nat. size), *ost*, omosternum; *sc*, scapula; *pcor*, ventral (precoracoidal) plate of scapula; *gl*, glenoid cavity; *cor*, coracoid. (In reality the omosternum is wedged in between the extremities of the coracoids.)

vary, being in some genera adapted for progression on land, in others converted into paddles suited for an aquatic existence. The humerus and femur are always of considerable length, the phalangeal bones are elongated, but no additional digits are developed. In habits the members of this order were carnivorous, and either marine or terrestrial.

PLESIOSAURIDÆ.—In Wall-cases Nos. 9 and 10, and in Table-case No. 17, are placed the remains of one of our largest marine reptiles, the *Pliosaurus*, from the Kimmeridge Clay, near Ely, and also from Dorsetshire. We have no entire skeleton of this animal, but the cast of a swimming-paddle (the original of

Pliosaurus. Wall-cases, Nos. 9, 10. Table-case, No. 15.

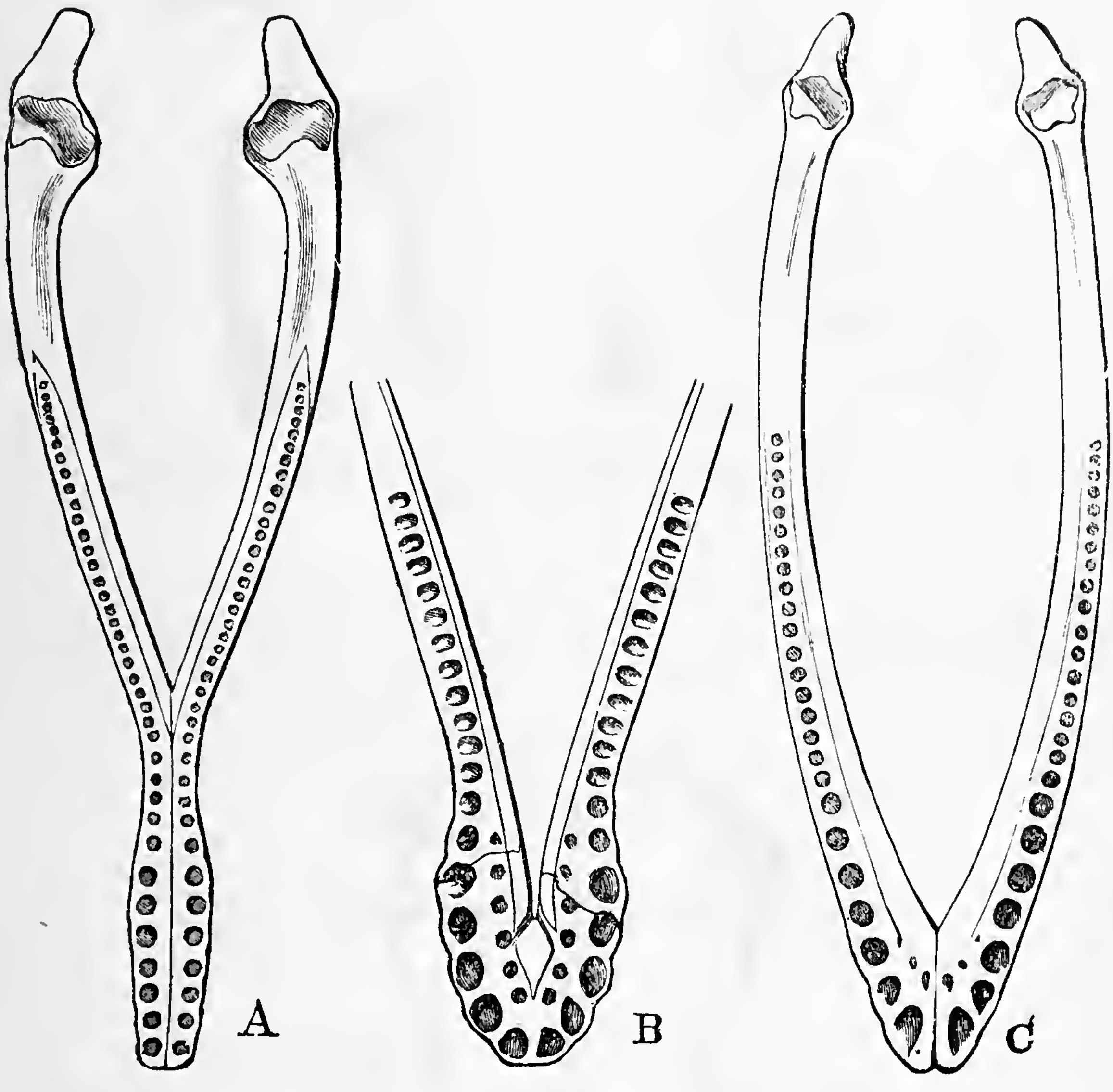


FIG. 63.—Sauropterygian mandibles. A, *Peloneustes philarchus* (Seeley); from the Oxford Clay, $\frac{1}{8}$. B, *Thaumatosaurus indicus* (Lydekker), Upper Jurassic of India, $\frac{1}{7}$. C, *Plesiosaurus dolichodirus*, (Conybeare); from the Lower Lias, Lyme Regis,

which is preserved in the Dorchester Museum) measures 7 feet in length; its jaw was 6 feet long, and one of its teeth was 15 inches in length. It had a shorter neck than the *Plesiosaurus*, but was probably less fish-like in aspect than *Ichthyosaurus*, which latter reptile it outrivalled in point of size.

In Wall-case No. 13, and in Table-cases Nos. 15, 16, 17, are arranged examples of the extinct group of marine reptiles, the PLESIOSAURIA (*see* Fig. 67, p. 49). They are distinguished at once by the great development of the neck, which is composed of numerous vertebræ. The head is comparatively small in size; the orbits are large; the limbs being shaped externally

Plesiosaurus. Wall case, No. 13, and Table-cases, Nos. 15, 16, 17.

Wall-cases, Nos. 9, 10, 13.

Table-cases, 15, 16, 17.

like the flippers of a whale, and made up of 5 fingers, composed of numerous phalanges. The jaws were armed with many simple pointed teeth inserted in distinct sockets. The most complete examples are the *Plesiosaurus Hawkinsii*, the *Pl.*

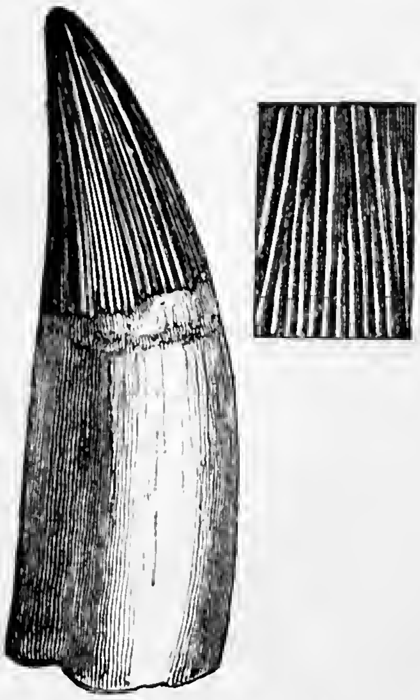


FIG. 64.—A tooth of *Polyptychodon interruptus* (Owen); Greensand, Cambridge.

FIG. 65.—An upper tooth of *Peloneustes philarchus* (Seeley); Oxford Clay, Bedford, $\frac{1}{1}$.

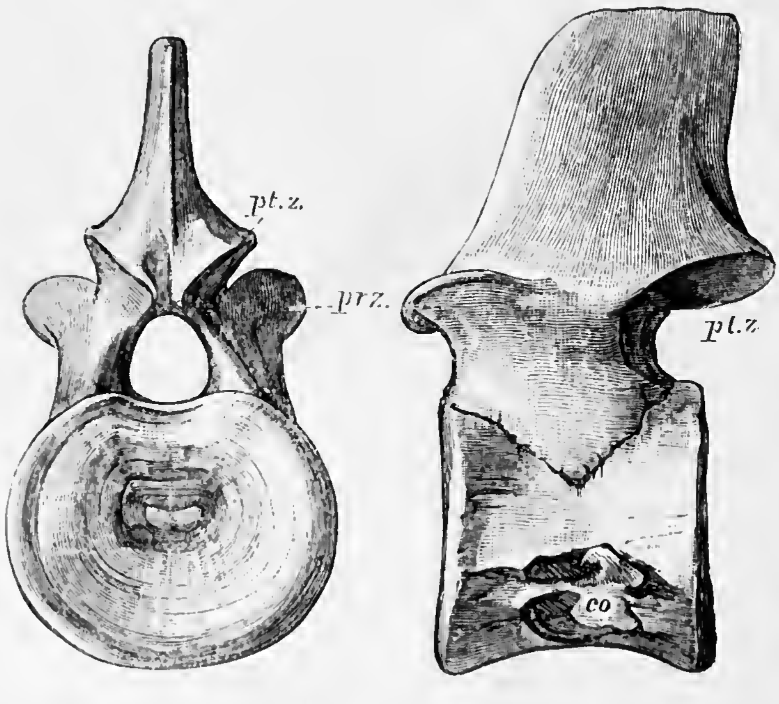


FIG. 66.—*Plesiosaurus hawkinsii* (Owen). Anterior and left lateral aspect of a late cervical vertebra from the Lower Lias of Lyme Regis, Dorset; *co*, costal facet; *prz*, prezygapophysis; *ptz*, postzygapophysis.

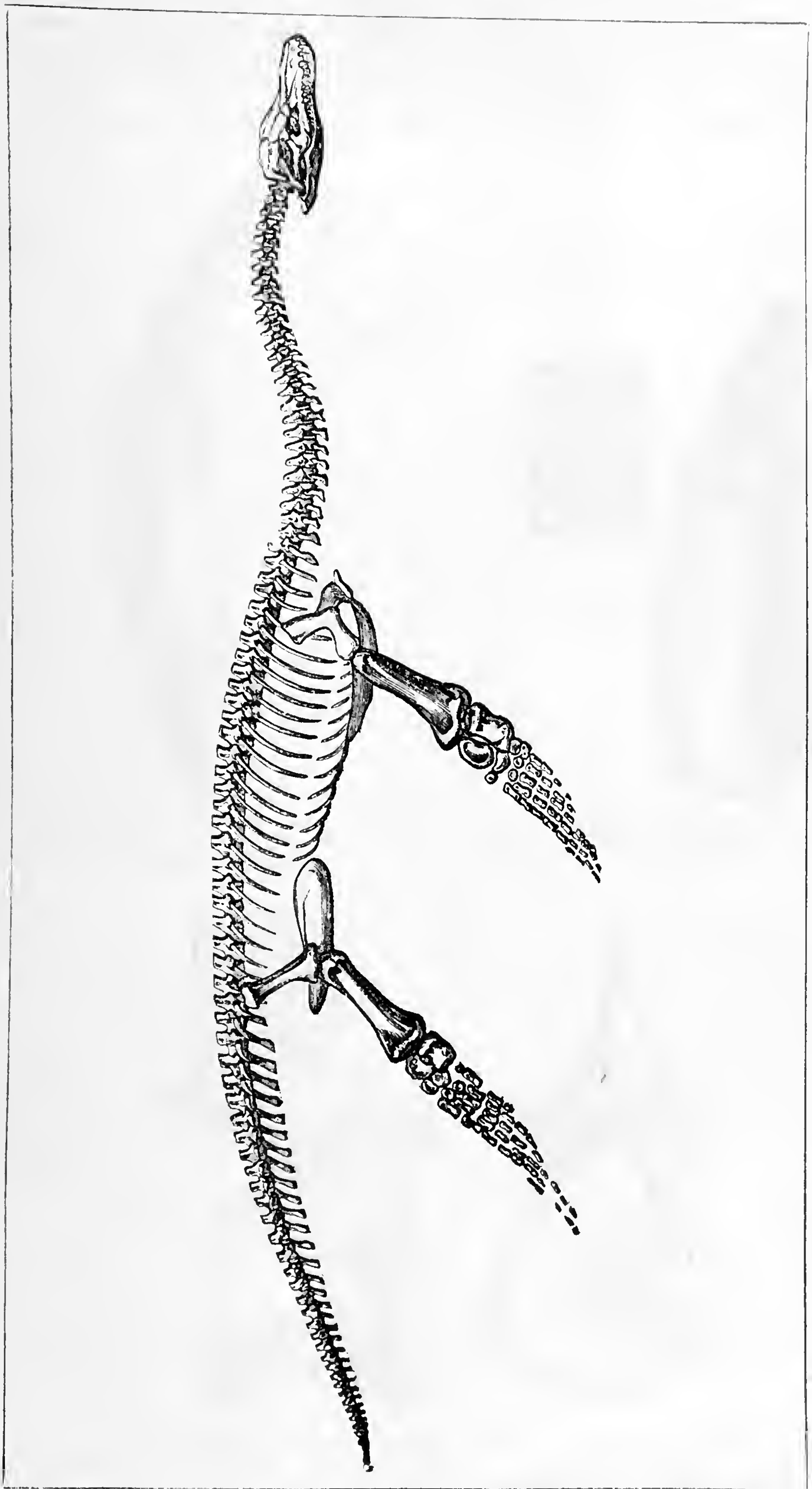


Fig. 67.—Skeleton of the Long-necked Sea-Lizard (*Plesiosaurus*), from the Lias of Lyme Regis, Dorset.

Wall-case, No. 13.

Wall-case, No. 13.

robustus, the *Pl. laticeps*, *Pl. macrocephalus*, all in Case No. 13; and the cast of the *Thaumatosaurus*, fixed on the wall of the East Corridor (No. 3 on Plan), leading to the S.E. gallery, which is 22′ 0″ in length and 14′ 0″ in breadth, measuring across its expanded paddles.

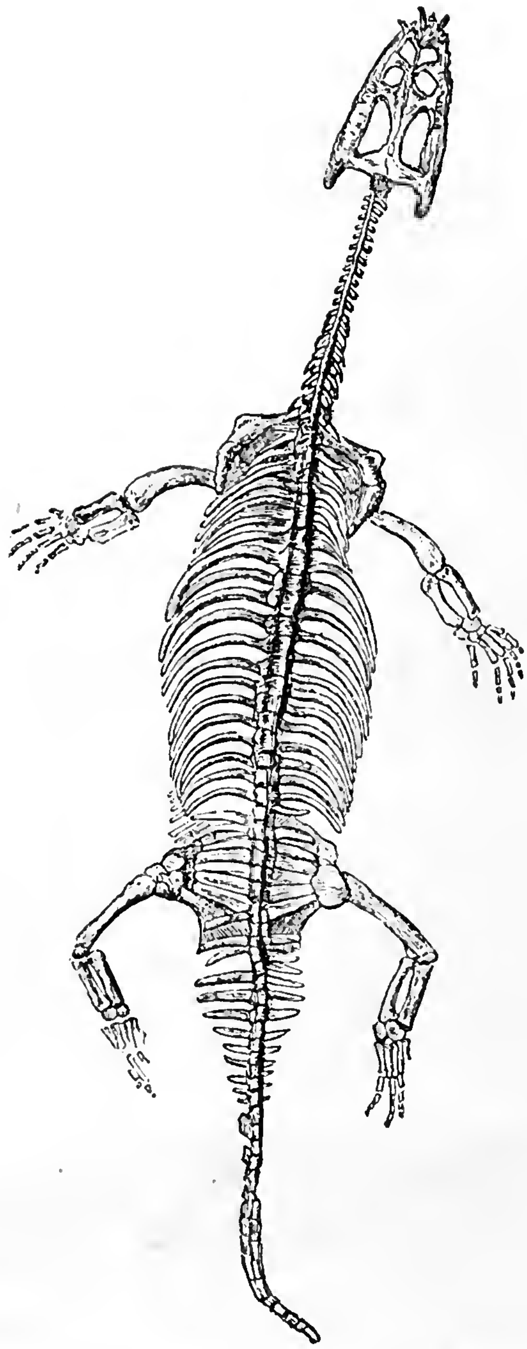


FIG. 68.—Skeleton of *Lariosaurus Balsami* (Curioni); Muschelkalk, Perledo, Lago di Como, Italy, (⅛ nat. size; original in the Munich Museum).

Wall-cases, Nos. 9, 10, 13. Table-cases, Nos. 15, 16, 17.

Within the family PLESIOSAURIDÆ are included several allied genera, namely, *Pliosaurus* (with five species); *Peloneustes* (with two species); *Thaumatosaurus* (with seven species); *Polyptychodon* (with two species); *Cimoliosaurus* (with twenty-eight species); *Eretmosaurus* (with two species); and the type-genus *Plesiosaurus* (with twelve species); in all, some fifty-eight

species. Only a few complete examples of some of these genera are known, the rest being mostly based upon more or less fragmentary remains. These old marine lizards were most abundant in Mesozoic times, particularly at the period of the deposition of the Lias, Kimmeridge and Oxford Clays; the latest-known genus, *Polyptychodon*, being found in the Chalk.

Nothosaurus.

Table-case, No. 17.

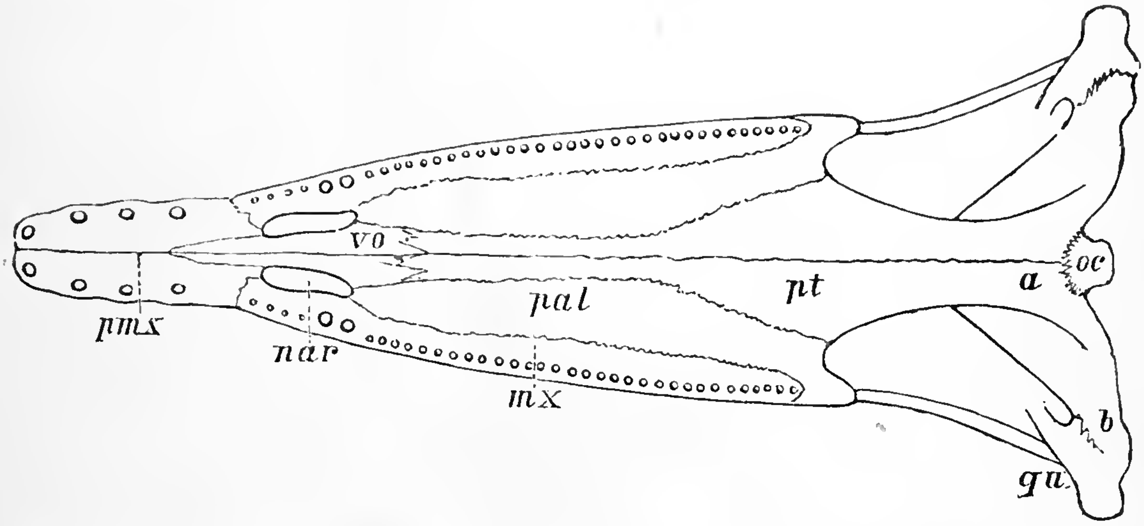


FIG. 69.—Palatal aspect of the cranium of *Nothosaurus mirabilis* (Münster), Muschelkalk, Germany (¼ nat. size). *pmx*, premaxilla; *nar*, posterior nares; *vo*, vomer; *mx*, maxilla; *pal*, palatine; *pt*, pterygoid; *a*, ala of same; *b*, quadratic ridge; *qu*, quadrate bone; *oc*, occipital condyle. The posterior extremity of the palatine was probably formed by a transverse bone, but the suture is not visible. (Table-case, No. 17.)

Most of the "Sea-Dragons," both the long and the short-necked forms, were obtained from the Lias of Street, Somersetshire, Lyme Regis, Dorsetshire, Barrow-on-Soar, Leicestershire, and Whitby in Yorkshire; or from the Oxford Clay of Peterborough and Weymouth, and the Kimmeridge Clay of Dorsetshire; in fact, their geological and geographical distribution seem to have been almost identical.

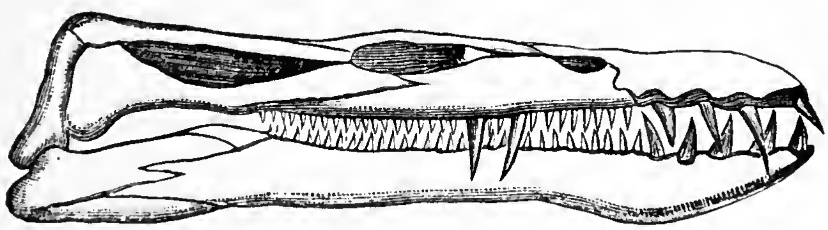


FIG. 70.—Right lateral aspect of the skull of *Nothosaurus mirabilis* (Münster), reduced; from the Muschelkalk of Germany.

The LARIOSAURIDÆ, represented by the Italian *Lariosaurus* and the German genus *Neusticosaurus*, appear to connect the marine PLESIOSAURIDÆ with the freshwater and terrestrial NOTHOSAURIDÆ. The skull was short, the neck relatively long; the humerus short, the femur elongated, and the terminal phalangeals were furnished with claws.

Wall-case, No. 7.

A cast of *Lariosaurus Balsami* and two original and nearly entire skeletons of *Neusticosaurus pusillus* from the Trias of Stuttgart may be seen in the cases.

Table-case, No. 17.

In *Nothosaurus* the skull is long and narrow with the post-orbital portion larger than the preorbital and with very long and narrow supratemporal fossæ; the upper teeth are numerous, and the 5th and 6th maxillary teeth much enlarged, the mandibular symphysis is of moderate length and bears 5 teeth; the dorsal vertebræ have very short transverse processes.

Table-case, No. 18.

Conchiosaurus is closely allied to *Nothosaurus; C. clavatus*, was about one half the size of *N. mirabilis*.

The genus *Mesosaurus*, a reptile discovered in the Karoo formation, Griqualand, S. Africa, and since met with in Brazil, is included in the same order with *Nothosaurus*. One of the most peculiar features in this genus is the separation of the fourth and fifth tarsalia, so that each metatarsal articulates

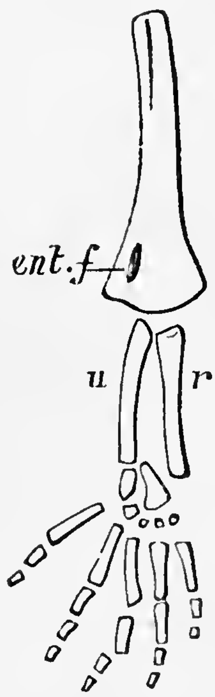


Fig. 71.—Ventral aspect of left pectoral limb of *Mesosaurus tenuidens* (P. Gervais), from the Karoo System (Trias), Griqualand West (South Africa) $\frac{1}{1}$ *ent. f.*, entepicondylar foramen of humerus; *r*, radius; *u*, ulna (*see* Table-case No. 18).

Fig. 72.—Ventral aspect of right humerus of *Conchiosaurus clavatus* (Meyer), Muschelkalk of Nurnberg ($\frac{1}{2}$ nat. size); *ent.f*, entepicondylar foramen; *a*, ectepicondylar groove.

with a distinct tarsale. The centra of the vertebræ have a notochordal canal, and are small in comparison to the neural arches; while the ribs were anchylosed to the vertebræ, and were of great thickness like those of *Nothosaurus*. Abdominal ribs were also present. The skull was much elongated, and furnished with slender recurved teeth, implanted in distinct sockets.

Order X.—PLACODONTIA (Plate-toothed Reptiles).

The genus *Cyamodus*, from the Muschelkalk of Germany, offers a remarkable modification in its dentition not usually met with in the reptilian class, but of which the class of fishes affords numerous examples. The skull is as broad as it is long, the greatest breadth being behind, whence the sides converge to an obtuse muzzle. The temporal fossæ are the widest and the zygomatic arches the strongest in the reptilian class, and the lower jaw presents a similar strong development of the coronoid process. This powerful action of the jaws for biting and grinding relates to the form and size of the teeth, which resemble paving-stones, and were evidently adapted to crack and bruise shells of Mollusca, Crustacea, and perhaps Echini also. (Owen.) **Cyamodus. Table-case, No. 18.**

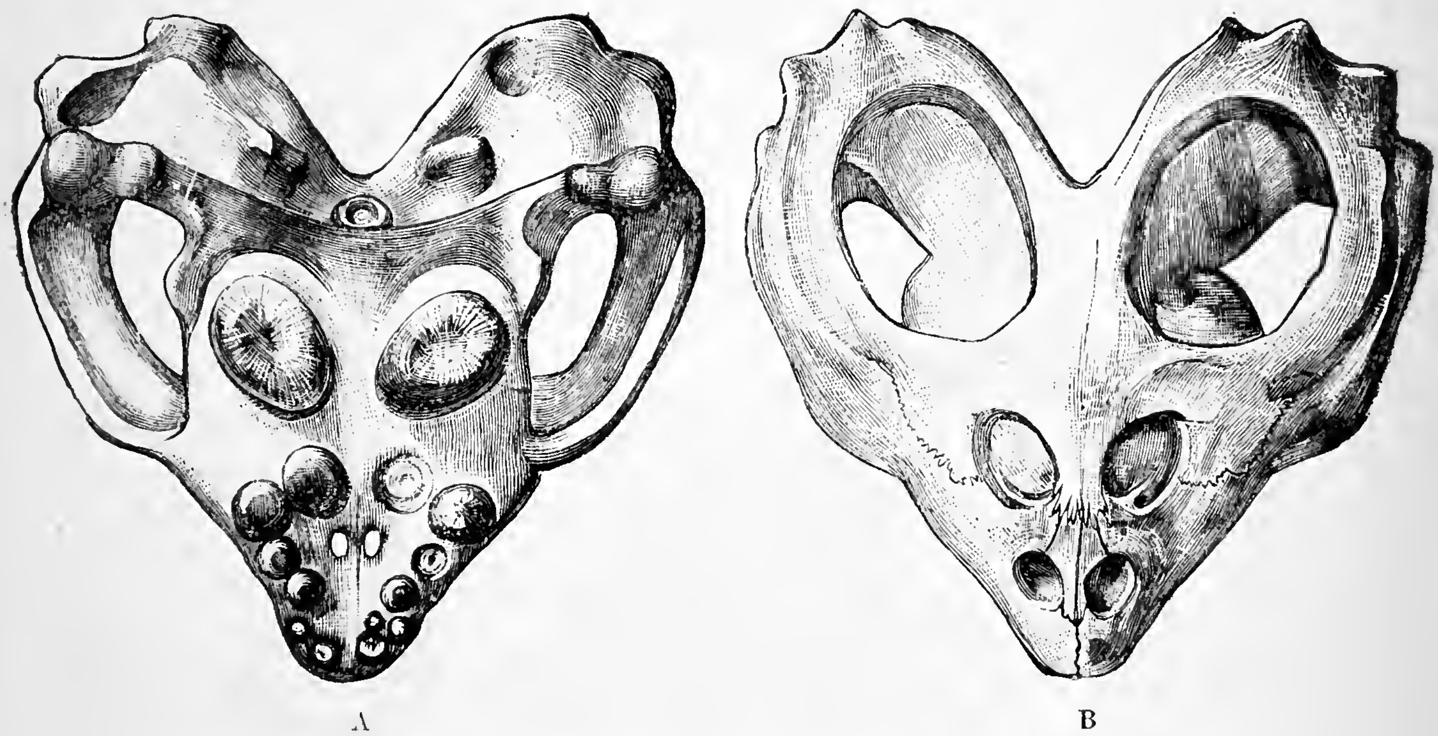


Fig. 73.—*Cyamodus* (*Placodus*) *laticeps* (Owen). A, palatal aspect; B, frontal aspect of cranium; from the Muschelkalk of Baireuth, Germany. (Table-case, No. 18.)

The upper jaw contains a double series of these teeth, an outer, or maxillary series, and an internal or palatal series; but the under jaw has only a single row of teeth.

Although now admitted to be a reptile, this remarkable genus was formerly classed by Münster and Agassiz as one of the Pycnodont fishes.

Placodus gigas (Agassiz). A closely allied form; has a more elongated cranium with a distinct premaxillary rostrum carrying three chisel-like teeth on each side. It has three polygonal palatine teeth and four or five maxillary ones. The cranium is more elevated than in *Cyamodus*. **Placodus.**

Order XI.—ANOMODONTIA.

Wall-cases, Nos. 7, 9.
Table-cases, Nos. 18, 19.

Order Anomodontia.—In this order the body is lacertiform (lizard-like), and the limbs are adapted for walking. The skull is comparatively short; the quadrate bone is fixed; a parietal foramen is present; there are either one or two temporal arcades; the nasals are large; in the palate the pterygoids meet together in front of the basisphenoid, which they also join, but diverge anteriorly; the palatine bones are small and placed internally to the pterygoids, as in Mammals. The dentition is *thecodont* (teeth placed in distinct sockets), but the teeth may be anchylosed to the bone. The vertebræ are *amphicœlous* (concave at both ends), and in some cases they have notochordal centra (centra gelatinous, unossified)*; the dorsal vertebræ have long tranverse processes, and the anterior ribs articulate by double heads. Abdominal ribs seem generally to have been absent. In the Pectoral girdle an interclavicle, clavicles, and precoracoids are present, and a sternum was probably always developed.

In the pelvis the pubis is placed in advance of the ischium to which it is completely united. The body of the ilium is in advance of the acetabulum. The tarsus has one centrale, and the phalangeal bones of the manus and pes are typically 2, 3, 3, 3, 3, in number as in Mammals; the whole structure of the foot being Mammalian in type. We are led to conclude, from recent researches, that these animals are directly descended from the Labyrinthodont Amphibians, more especially from the Archægosaurian family. They are also related in all probability to Monotreme Mammals.

This order appears to be confined to the Permian and Trias.

Sub-order 1.—**Procolophonia.**

Table-case, No. 19.

To the Anomodontia are now referred the small reptiles of the genus *Procolophon*, with a short triangular and somewhat depressed skull; their dentition is carnivorous but the marginal teeth are all alike and are completely anchylosed to the bone; teeth are also borne upon the vomer and the pterygoids. *Procolophon* presents many points of resemblance to *Sphenodon* and the *Rhynchosauridæ*. The genus is met with in the Karoo Beds (Trias), of South Africa.

Sub-order 2.—**Dicynodontia** (Double Dog-toothed).

Dicynodon.
Wall-case, No. 9.
Table-case, No. 19.

Family Dicynodontidæ.—The Dicynodonts† are a very peculiar family of reptiles from the Trias of South Africa.

* The circumference of the centrum is in some species ossified so as to form a bony tube, while the centre remains gelatinous.

† The genus, *Dicynodon*, is so called from δια, two, and κυνοδος, canine tooth, from the two tusk-like canines in the upper jaw.

The skull is massive and remarkable in form, and is furnished with a single pair of huge sharp-pointed tusks growing downwards, one from each side of the upper jaw, like the tusks in the Walrus. No other kind of teeth were developed in these singular animals; but the premaxillaries were confluent and sharp-edged, and formed with the lower jaw a beak-like mouth, probably sheathed in horn like the Turtles and Tortoises.

Wall-case, No. 9.

Table-case, No. 19.

Dicynodon.

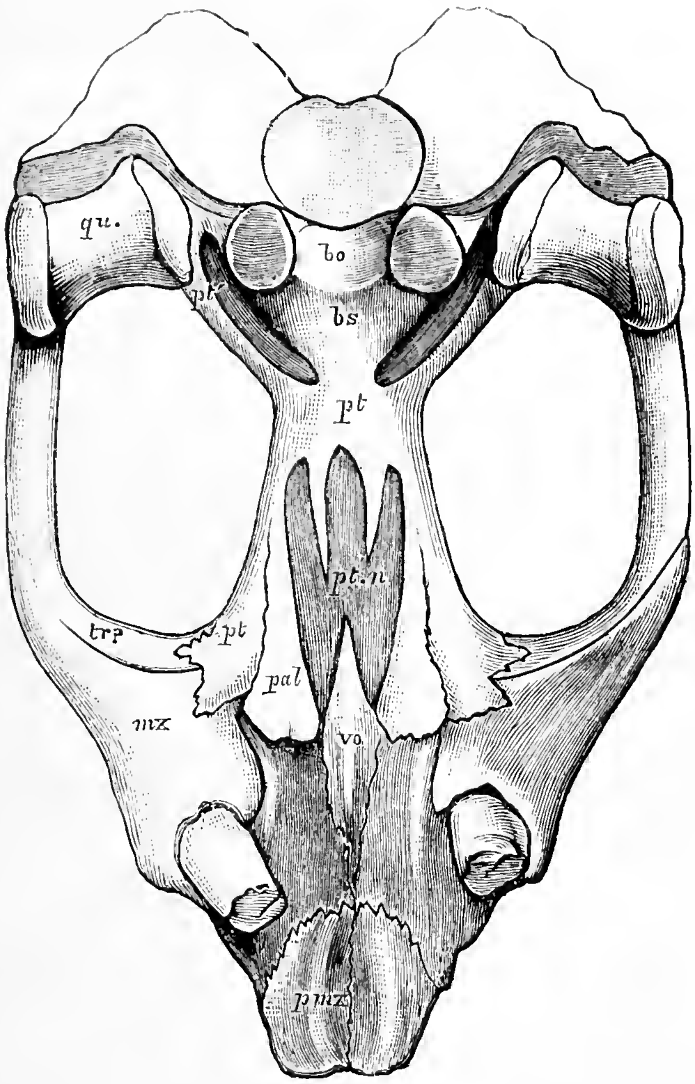


FIG. 74.—Palatal aspect of cranium of *Dicynodon*, from the Karoo series of the Cape of Good Hope, S. Africa. $\frac{1}{2}$ *pmx*, premaxilla; *mx*, maxilla; *vo*, vomer; *pal*, palatine; *pt*, pterygoid; *bs*, basisphenoid; *bo*, basioccipital; *qu*, quadrate; *tr?* transverse bone?; *ptn*, posterior nares.

Several species have been described from the Stormberg and Beaufort Beds of the Karoo series of South Africa, and the equivalent Gondwana series of Central India. So long ago as 1885 remains of the genus were stated* to have been discovered in the reptiliferous sandstone of Elgin, Scotland, but they have not yet been described or figured (1890).

Dicynodon.

* *See* Prof. Judd's letter, "Nature," 1885, and Dr. R. H. Traquair, "British Association Reports," Aberdeen Meeting, 1885.

Table-case, No. 19.

Oudenodon.

In *Oudenodon* both jaws were edentulous; the maxillæ have a sharp external beak-like ridge; the palate has a vomerine

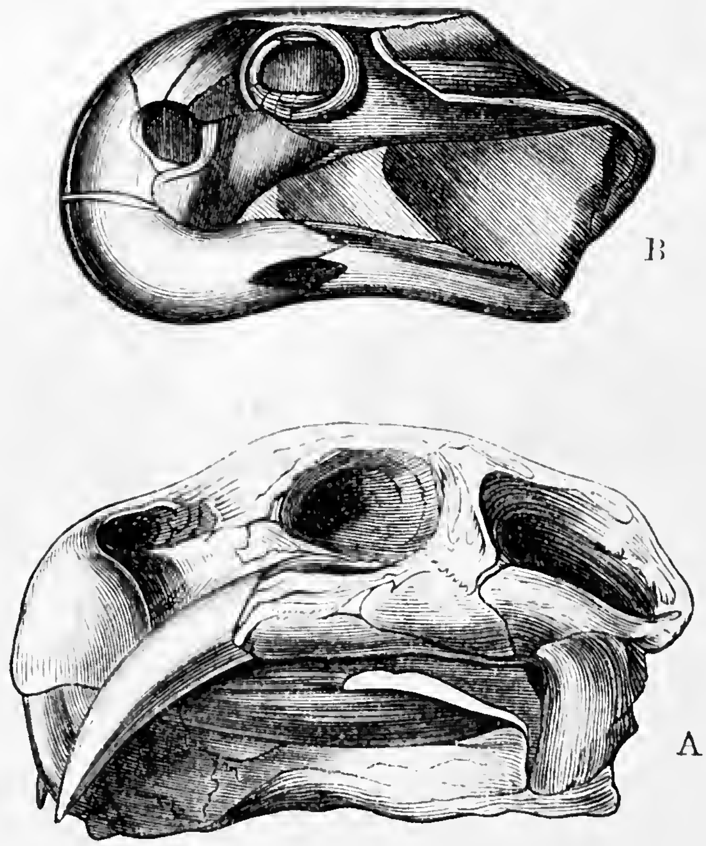


FIG. 75.—Lateral views of the skulls of (*A*), *Dicynodon lacerticeps* (Owen); and, (*B*), *Oudenodon Baini* (Owen); from the Karoo series, South Africa.

Dicynodon.

ridge, and the general shape of the skull resembles *Dicynodon*. Several species have been described by Owen, all from South Africa.

Table-case, No. 18.

Endothiodon.

Family ENDOTHIODONTIDÆ.– This family includes a number of large reptiles from the Karoo formation of the Cape, of which the genus *Endothiodon* forms the type. They are distinguished from the preceding by the presence of numerous teeth on the palate. The skull resembles *Oudenodon*, but the muzzle is more elongated and the nares (nostrils) are terminal and are overhung by massive nasal bones. The border of the jaws has a cutting edge, but the surface of the palate and mandible carry one or more longitudinal rows of columnar and cylindrical teeth. The palate of *Endothiodon* is remarkably mammalian in type.

SUB-ORDER 3.—**Theriodontia.**

Theriodontia.

Table-case, No. 19.

Family TAPINOCEPHALIDÆ.—This family includes remains of two large forms from the Karoo beds, South Africa, namely, *Tapinocephalus* and *Titanosuchus*. Their dentition indicates a carnivorous type of reptiles. An imperfect skull, several entire limb-bones, and vertebræ are preserved in the Collection.

Tapinocephalus is represented by an imperfect portion of skull, also several entire limb-bones and vertebræ.

Wall-case, No. 7. Tapinocephalus.

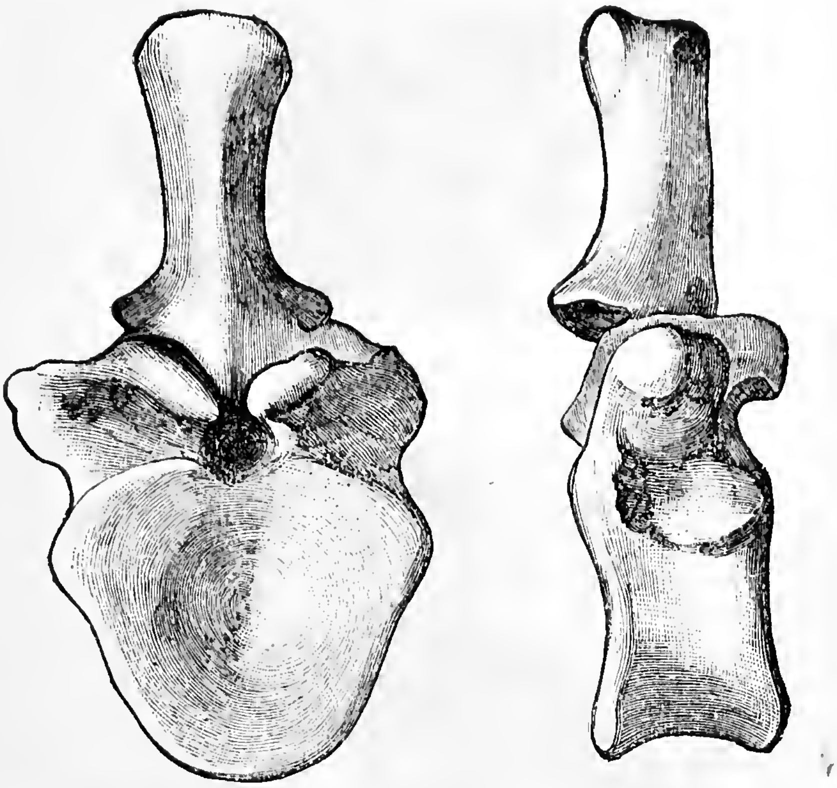


Fig. 76.—Anterior and right lateral aspects of a lumbar vertebra of *Tapinocephalus Atherstonei* (Owen); from the Karoo Beds, South Africa.

Family Galesauridæ.—Nearly the whole of the typical Theriodontia are included in this family. They form a remarkable group of carnivorous reptiles, first described and thus named by Sir Richard Owen* in reference to the form and order of arrangement of the teeth bearing a greater resemblance to the

Table-case, No. 19.

Galesaurus.

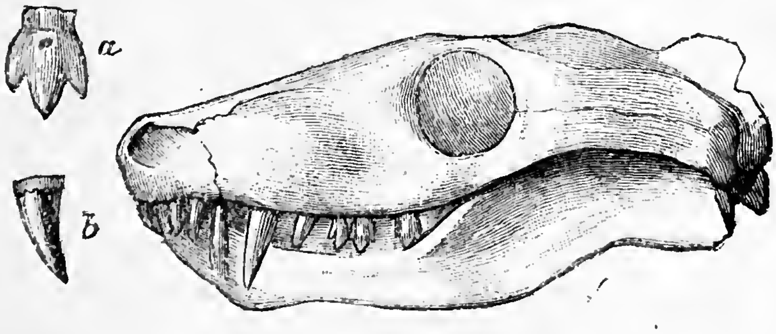


Fig. 77.—Left lateral aspect of skull of *Galesaurus planiceps* (Owen), from the Karoo beds (Triassic), South Africa ($\frac{1}{3}$ nat. size). *a*, an upper cheek-tooth, and *b*, an incisive tooth.

dentition of the Mammalia than any other group of the class Reptilia, for, as in the carnivorous mammals, the incisors are separated from the molars by well-developed canines; and the canines of the lower jaw crossed those of the upper in front. In

* "Catalogue of the Foss. Rept. of South Africa," 4to, Lond. 1876.

Table-case, No. 19.

Æluro-saurus.

many of the genera the upper canines are long and trenchant, and the incisors large and close together (*Lycosaurus*, *Ælurosaurus*, etc.), the molars, as a rule, being smaller than the incisors. In

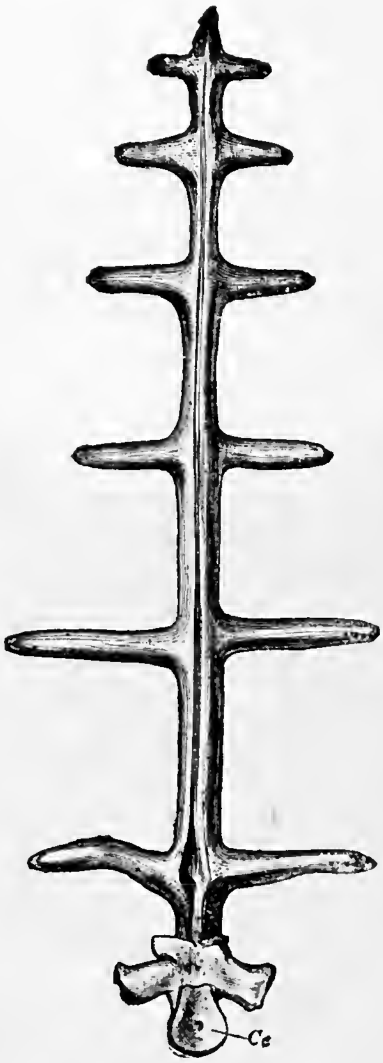


FIG. 78.—Anterior view of a dorsal vertebra of *Naosaurus claviger* (Cope), from the Permian of Texas ($\frac{1}{6}$ nat. size: *ce*, centrum).

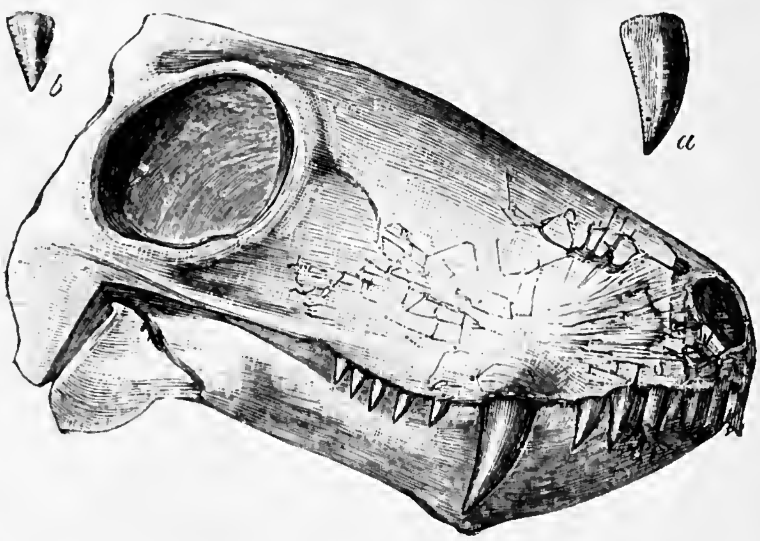


FIG. 79.—Right lateral aspect of imperfect cranium of *Ælurosaurus felinus* (Owen); from the Karoo Beds (Triassic), Beaufort West, South Africa ($\frac{2}{3}$ nat. size). *a*, upper incisive tooth; *b*, upper cheek-tooth, enlarged.

most reptiles, living and extinct, the teeth that are worn away by use, or otherwise lost, are replaced by others that are constantly forming in the jaws; but there is no evidence of preceding teeth, like the milk-teeth in mammals, nor of successional teeth, in the jaws of the Theriodonts. From this negative evidence Sir Richard Owen assumes them to have been "Monophyodont" reptiles, having but one set of teeth, which were permanent, during life. He has described eleven genera, varying in the size and form of the skull and teeth. The specimens exhibited have all been obtained from rocks of Triassic age in South Africa, and are the type-specimens of the species figured and described in the work already quoted.

Table-case, No. 19.

Teeth of Theriodontia.

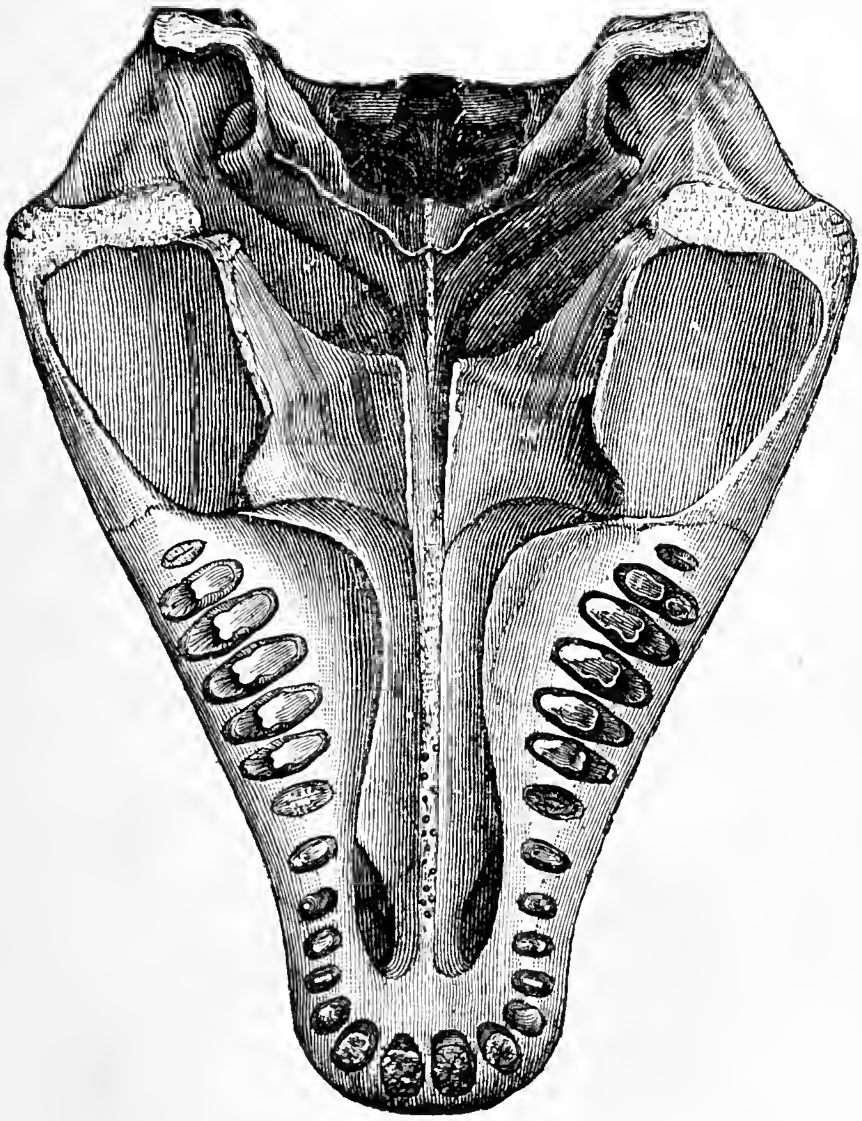


Fig. 80.—A, Palatal, and B, Occipital aspect of cranium of *Empedias molaris* (Cope); ¼ nat. size, from the Permian of Texas, North America.

Family Clepsydropidæ.—These Theriodonts differ from the Galesauridæ either in having teeth on the palate, or by the extraordinary character of their dorsal vertebræ, in which large intercentra are typically present. These forms all belong to

Naosaurus.

Gallery, No. 4. Table-case, No. 19. Empedias.

the Permian formation of North America. The premaxillary and maxillary teeth are of unequal size, as in *Galesaurus*, with two tusks near the extremity of the dentary bone. In *Dimetrodon* and *Naosaurus* the neural spines of the dorsal vertebræ have an extraordinary development; the height of the spine in one species being more than twenty times the length of the centrum. Prof. Cope concludes that these spines formed a kind of elevated fin on the back, of which it is difficult to imagine the use. In *Naosaurus* there were horizontal processes on the spines of the vertebræ. This genus has also been recorded from the Permian of Bohemia (*see* Fig. 78, p. 58.)

Family Diadectidæ.—In the Diadectidæ, represented by the genera *Diadectes*, *Empedias*, and *Helodectes*, the teeth are transversely elongated, and are also divided by a median vertical ridge, but both the inner and outer sides are equally low. They are believed to have been herbivorous in diet.

These genera are characteristic of the Permian of North America; *see* Figs. 80 and 81, *Empedias molaris* (Cope).

Family Bolosauridæ.—Another closely related form, referred to the family of Bolosauridæ, named *Deuterosaurus*, is found in the Permian of Russia (Fig. 82).

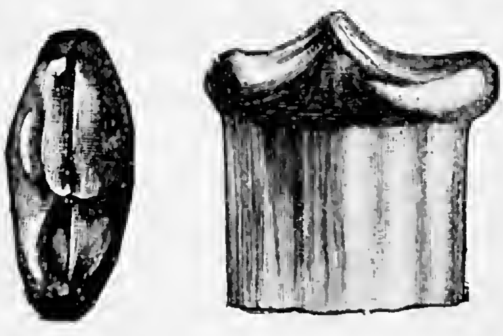


Fig. 81.—Lateral and palatal view of posterior tooth of *Empedias molaris* (Cope); Permian, North America.

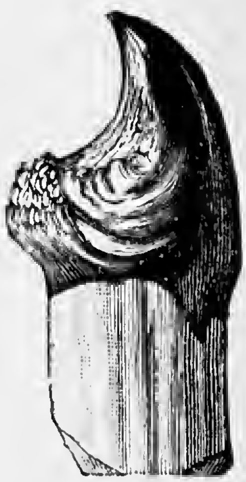


Fig. 82.—Lateral view of a premolar of *Deuterosaurus biarmicus* (Eichwald), from the Upper Permian of Russia.

A tooth has been obtained from the Karoo beds of South Africa closely resembling in general characters the anterior teeth of *Deuterosaurus*. It has been made the type of the genus *Glaridodon*.

Sub-order 4.—Pariasauria.

Wall-case, No. 7, and Table-case, No. 19.

In this sub-order are placed the remains of several other genera of Anomodonts. They include *Pariasaurus*, *Anthodon*, and *Propappus*, from the Triassic deposits of South Africa.

Gallery, No. 4. Pariasaurus. Glass-case, zz. Wall-case, No. 7.

Pariasaurus serridens was obtained by Mr. Bain from the reptiliferous Triassic sandstone near the Winterberg, Cape Colony. The teeth are close-set, in an alveolar groove; they resemble those of the *Iguanodon* in their mode of implantation, and those of the *Scelidosaurus* in their close arrangement and nearly uniform wear. The degree of abrasion indicates, as in the *Iguanodon*, that they were applied to the mastication of vegetable substances.

Fifteen or sixteen teeth are closely set on each side of both the upper and lower jaws. As in man, there is no diastema in the dental series, no one tooth is longer than the rest. But there is still greater uniformity in the teeth of this ancient reptile. There is absolutely no character by which to separate the incisors, or canines, or false or true molars. All the teeth are equally worn, and show by their abraded border that they have taken an equal share in the pounding as well as the cropping of the vegetable food upon which it subsisted (Owen).

The animal measures fully nine feet in length, and the shape of its skull and jaws are remarkably like those of the Batrachia.*

This fine example of the skeleton of *Pariasaurus* is exhibited in a glass-case (marked zz), at the west-end of Gallery, No. 4.*

In addition to the sculpture on the bones of the skull mucous canals, like those of the Labyrinthodonts, are also present. Vomerine teeth have also been observed.

Professor Seeley concludes that this very remarkable and Amphibian-like reptile is a direct descendant from the Labyrinthodonts; the chief affinities to that group being displayed in the characters of the skull, in the notochordal canal, and the large arches of the vertebræ, in the support of the pelvis by a single vertebra, as well as in the characters of the pectoral and pelvic girdles. The latter features, together with the general structure of the palate, being identical with those of typical Anomodonts, there appears every reason for referring this family to a sub-order of that group.

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* Other even more perfect remains of this genus have been quite recently obtained by Prof. H. G. Seeley, F.R.S., during a visit to the Cape Colony to study the Reptiliferous deposits of South Africa. They are now (1890) being developed from the matrix by the Formatore.

Class 4.—AMPHIBIA.

Amphibia. Gallery, No. 4. Table-cases, Nos. 23 and 24.

West Corridor, No. 5. Wall-case, No. 11.

In Wall-case No. 11, and in Table-cases Nos. 23 and 24, are placed the fossil Amphibia or Batrachia (Frogs, Toads, Newts, and Salamanders). These animals are distinguished from true reptiles by the fact that the young undergo certain metamorphoses after leaving the egg. In this stage of their existence they breathe by external gills: these gills are occasionally retained along with internal lungs in the adult animal. The limbs are sometimes all absent, or one pair may be wanting. When present, they have the same bones as in the higher animals; they are never converted into fins. The skull has two occipital condyles and a persistently cartilaginous basi- and supra-occipital. The suspensorial apparatus of the mandible is continuous with the skull. Teeth are commonly present on the premaxilla, maxilla, vomer, and the dentary bone of the mandible. They are usually anchylosed to the bone and are simple in structure; but in the Labyrinthodonts they are more complex. There are never more than two vertebræ coalesced to form the sacrum. The tail is comparatively short. The centrum of the backbone is sometimes found to be unossified, forming a mere ring of bone, the interior being gelatinous. This form of backbone is called "Notochordal," and is characteristic of the oldest reptilia belonging to this group met with fossil in the Coal Measures, such as the *Anthracosaurus*, *Archægosaurus*, and the Triassic Labyrinthodonts.

Order I.—ECAUDATA. (Tailless Batrachia, Frogs and Toads.)

Table-case, No. 24.

Batrachia; Frogs, Toads.

The body of adult is short, destitute of a tail, and furnished with four limbs, of which the pelvic pair are the larger and adapted for leaping. There are no gills in the adult. Skull short and wide, with the parietals confluent with the frontals, and the orbits usually undefined; præsacral vertebræ few in number, and generally procœlous; there is only one sacral vertebra, and the vertebral column terminates in a long urostyle; dorsal ribs are usually absent. Ilia prolonged backwards, so as to throw the acetabulum far behind the sacrum; radius and ulna, and tibia and fibula respectively fused together, calcaneum and astragalus elongated: Four digits in the hand and five in the foot; an additional ossicle in the pes may represent the prehallux.

The tailless *Batrachia* (frogs and toads) do not date back further in time than the Upper Eocene.

The European genus *Bombinator* is probably represented in the Upper Miocene of Switzerland and the Middle Miocene of Sansan, France. Another genus *Bufavus*, occurs in the Middle Tertiary of Italy. *Pelobates* is found in the Miocene of Sansan,

and *Protopelobates* in that of Bohemia. The extinct family of Palæobatrachidæ has teeth in the upper jaw and no ribs; it was widely distributed over the continent of Europe in Miocene times, and was represented by a single genus *Palæobatrachus*, and more than a dozen species from various localities.

Table-case, No. 24.

Batrachia; Frogs, Toads.

The true toads, Bufonidæ, have no teeth or dorsal ribs. Existing species of the genus *Bufo* occur in the European and Indian Pliocene deposits. *B. Gesneri* from the Upper Miocene of Switzerland agrees closely with the living *B. viridis*. Dr. Filhol records the type-genus from the Upper Eocene "Phosphate-deposits" of France.

The huge *Ceratophrys cornutus*, or Horned Frog of Brazil, occurs in the Cave deposits of that country; and the genus *Latonia* in the Miocene of Switzerland.

The Ranidæ, or true frogs, have teeth in the upper jaw and the extremities of the sacral ribs are not expanded. Species of *Rana* are found in the Norfolk Forest Bed, in the Pleistocene of Sardinia, the Miocene of Sansan; two are from the Brown Coal of Rott, near Bonn, others from the Upper Eocene Phosphorites of Caylux, France; several forms occur in the Middle Tertiary of Italy, &c.

Order II.—CAUDATA. (Salamanders, &c.)

In this order the body of the animal resembles that of a Lizard, or is still more elongated like that of an Eel; in some there are four limbs present, in others only the anterior pair are

Wall-case, No. 11.

Table-case, No. 24.

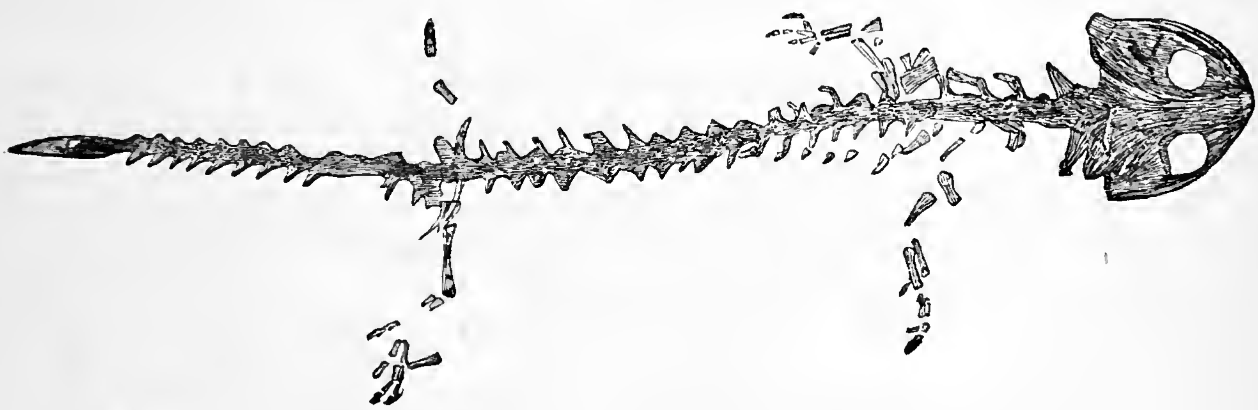


Fig. 83.—The great Fossil Salamander *Megalobatrachus* (*Cryptobranchus*) *Scheuchzeri* (Holl), from the Upper Miocene, Œningen, Switzerland.

developed. The external gills of the larva are occasionally retained in the adult animal. *Hylæobatrachus* is found in the Wealden of Belgium and may be an ancestral form allied to the *Proteidæ* but distinguished by the presence of a maxilla and five digits to the feet. (The only specimen known is in the Brussels Museum.)

Salamanders.

In the family of Amphiumidæ is placed *Megalobatrachus*

Wall-case, No. 11.

(*Cryptobranchus*) represented by the gigantic Salamander (*M. maximus*) of China and Japan, with which we may probably include the large Salamander from the Upper Miocene of Oeningen, Switzerland, originally regarded as the remains of a fossil man, and described by Scheuchzer as "*homo diluvii testis*," the man who witnessed the Deluge!

Table-case, No. 24.

Cryptobranchus Tschudii (Meyer) a much smaller form than *C. maximus*, but with a skull of nearly the same form is from the Miocene Brown-coal beds of Rott, near Bonn, in the Siebengebirge.

The true Salamanders lose their gills, when adult, but in some individuals of *Amblystoma* they are persistent. The existing crested Newt (*Molge cristata*) is found in the Norfolk Forest-bed, other representatives occur in the Middle and Lower Miocene of Europe. *Chelotriton* is found in the Lower Miocene of Allier; *Heliarchon* in the Brown Coal of Bonn, and *Megalotriton* in the Upper Eocene Phosphorites of Central France.

Order III.—LABYRINTHODONTIA.

Wall-case, No. 11.

In this order the body is long lizard-like (occasionally snake-like in form) with a tail, the pectoral limbs shorter than the

Table-cases, Nos. 23, 24.

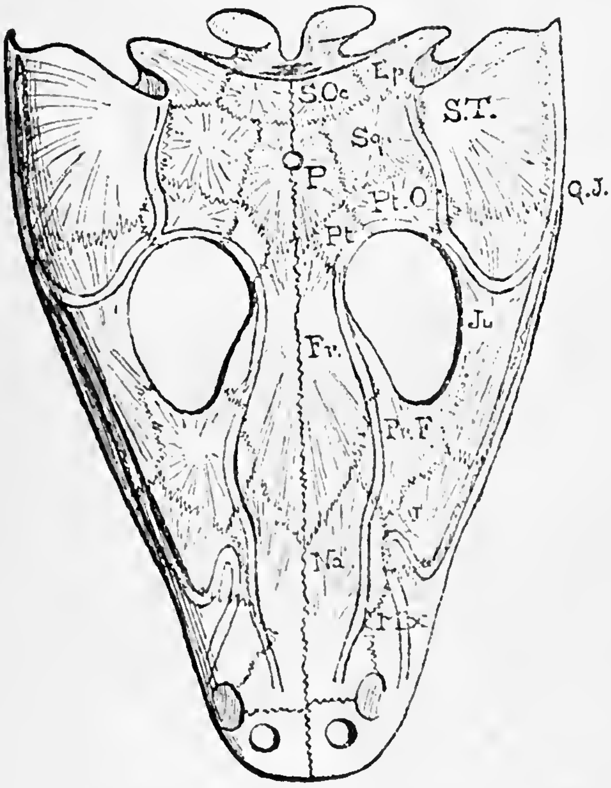


FIG. 84.—*Mastodonsaurus giganteus* (Jaeger), from the Lettenkohle (Lowest Keuper) of Würtemberg; about ⅙. Frontal aspect of the cranium with the sculpture omitted; *SOc* supraoccipital; *Ep*, epiotic; *P*, parietal; *Sq*, squamosal; *ST*, supratemporal; *Q.J*, quadratojugal; *Ju*, jugal; *Pt*, postfrontal; *PtO*, postorbital; *Fr*, frontal; *Pr.F*, prefrontal; *L*, lachrymal; *Na*, nasal; *Mx*, maxilla; the premaxilla has no letter. (After Fraas.)

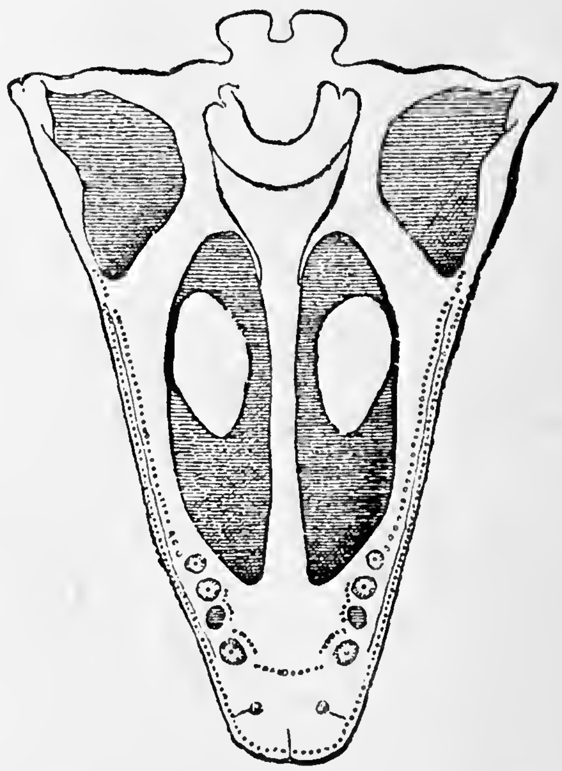


FIG. 85.—Palatal aspect of cranium of *Mastodonsaurus giganteus* (Jaeger); from the Lower Keuper of Würtemberg. (After Miall.)

pelvic; the feet pentadactyle. Skull with the temporal region completely roofed over by the post-orbital and supra-temporal bones, with a parietal foramen. Teeth pointed, having a large pulp-cavity and the dentine simple or plicated. Vertebræ amphicœlous and ossified, but a notochordal canal is often present. A bony thoracic buckler on the ventral aspect. Bony scutes frequently present on the ventral aspect of the body. Teeth are generally present on the palatines and vomer and more rarely on the pterygoids. There is generally an ossified sclerotic ring.

Wall-case, No. 11.

Table-cases, Nos. 23, 24.

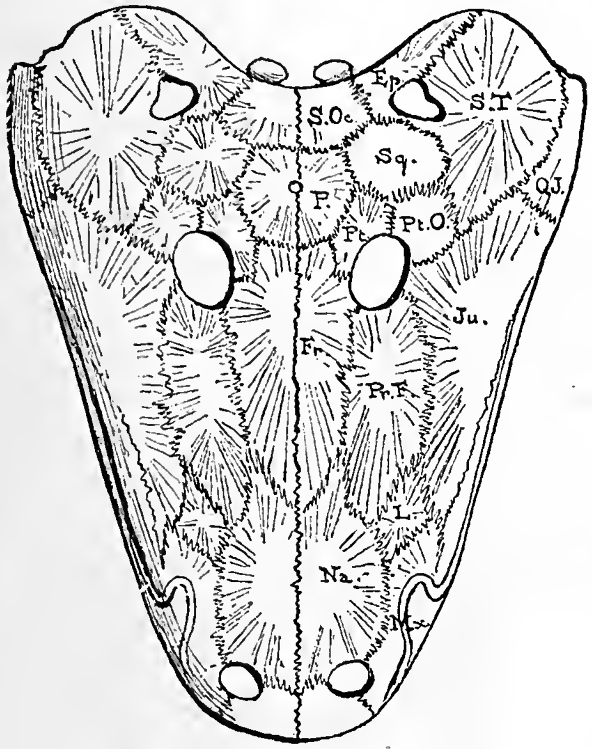


FIG. 86.—Frontal aspect of cranium of *Capitosaurus robustus* (Meyer); Middle Keuper (Upper Trias), near Stuttgart, Würtemberg. Letters as in Fig. 84. ($\frac{1}{3}$ nat. size.)

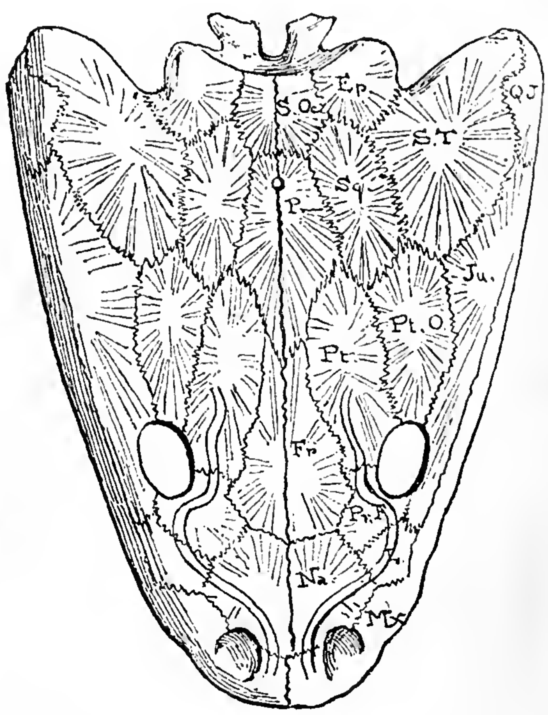


FIG. 87.—Frontal aspect of the cranium of *Metoposaurus diagnosticus* (Meyer), Upper Trias, near Stuttgart. Letters as in Fig. 84. ($\frac{1}{6}$ nat. size.)

The Labyrinthodonts were frequently of large size; the dentine of the teeth was usually plicated; the cranial bones were deeply sculptured and usually marked by numerous mucous canals, similar to those observed in skulls of the higher Pariasauria and Crocodilia. Professor Seeley regards these groups as directly descended from the Labyrinthodonts.

The Labyrinthodonts range from the Carboniferous to the Trias, and were especially abundant in the Permian epoch. One genus (*Rhinosaurus*) persisted to Lower Jurassic times.

One of the largest of these forms is the *Mastodonsaurus giganteus* (Jäger), from the Keuper of Würtemberg, the skull of which measures a yard in length, and broad in proportion; the snout is obtuse, the nares are oval and widely separated;

Wall case, No. 11.

the orbits are oval, but narrow in front, and are some distance in advance of the parietal foramen (*see* Fig. 84).

Capitosaurus and *Metoposaurus* occur in the Upper Trias of Stuttgart; in the former the orbits are elliptical, and approximate to the parietal foramen; in the latter they are oval, and situated in the anterior half of the skull, and widely separated from one another. (Figs. 86, 87.)

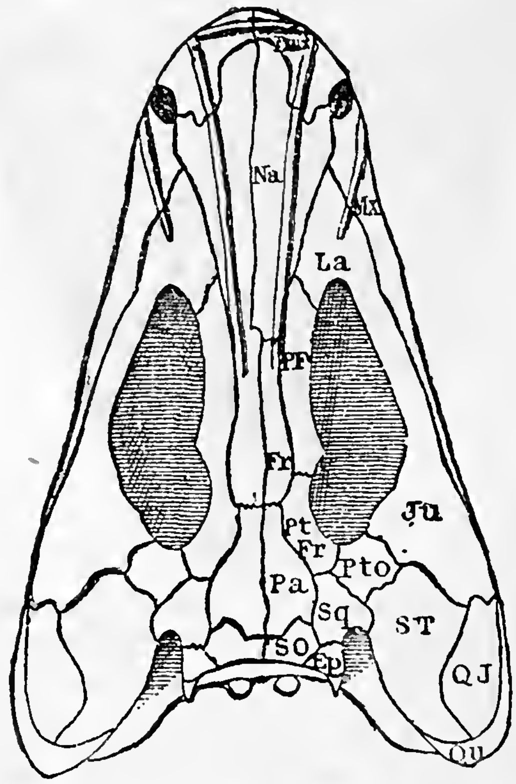


FIG. 88.—*Loxomma Allmani* (Huxley). Frontal aspect of cranium with the sculpture omitted; from the Carboniferous of Northumberland. About $\frac{1}{5}$. *PF*, prefrontal. Other letters as in Fig. 84. (*After Miall.*)

In the ANTHRACOSAURIDÆ, represented by *Loxomma*, the skull is vaulted with a broad and somewhat spatulate muzzle; the length of skull being about 14 inches by 9 inches in breadth. In this family the vertebral column is fully ossified in the adult; the teeth are deeply infolded; the mucous canals between the orbits and the nares form a lyre-shaped pattern, known as the *lyra*; and the ventral surface of the body typically has a covering of bony scutes.

Loxomma.

Wall-case, No. 11.

In Wall-case 11 is placed a very beautifully preserved skull of a Labyrinthodont Reptile from the Coal Measures of Shropshire, referred to *Loxomma Allmani* (Huxley). The specimen is preserved uncrushed and shows the natural contour of the skull and lower jaw, admirably preserved in clay-ironstone. It was presented by George Maw, Esq., F.L.S., F.G.S.

This family comprises *Baphetes*, from the Carboniferous of Nova Scotia; *Anthracosaurus* and *Loxomma*, from the Lower Carboniferous of Burdiehouse, near Edinburgh, and the Coal Measures of Lanarkshire and Northumberland; *Macromerium*,

from Bohemia; *Eosaurus*, from Nova Scotia; *Nyrania*, from Bohemia; *Ichthyerpetum*, from Jarrow Colliery, Kilkenny; *Dendrerpetum*, from the Lowest Permian, Bohemia; *Brachyops*, from the Permian, Mangali, India; *Bothriceps* and *Micropholis*, from South Africa. **Table-cases, Nos. 23 and 24.**

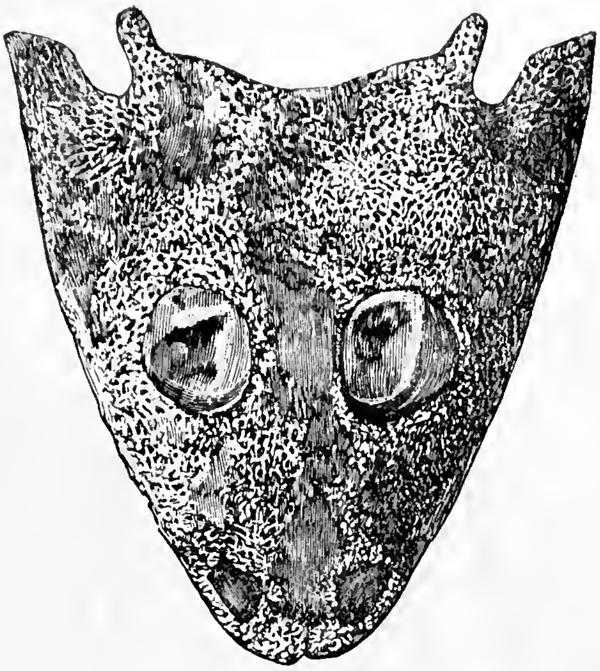


Fig. 89.—*Bothriceps huxleyi* (Lydekker). Frontal aspect of the skull; from the Karoo system of the Orange Free State, South Africa. $\frac{4}{5}$.

In *Bothriceps* the surface of the cranium is closely and irregularly pitted; the orbits are placed near the middle of the skull. This small form measures about $2\frac{1}{4}$ inches in length, and 2 in breadth. It was obtained from the Karoo beds (Triassic?) of South Africa.

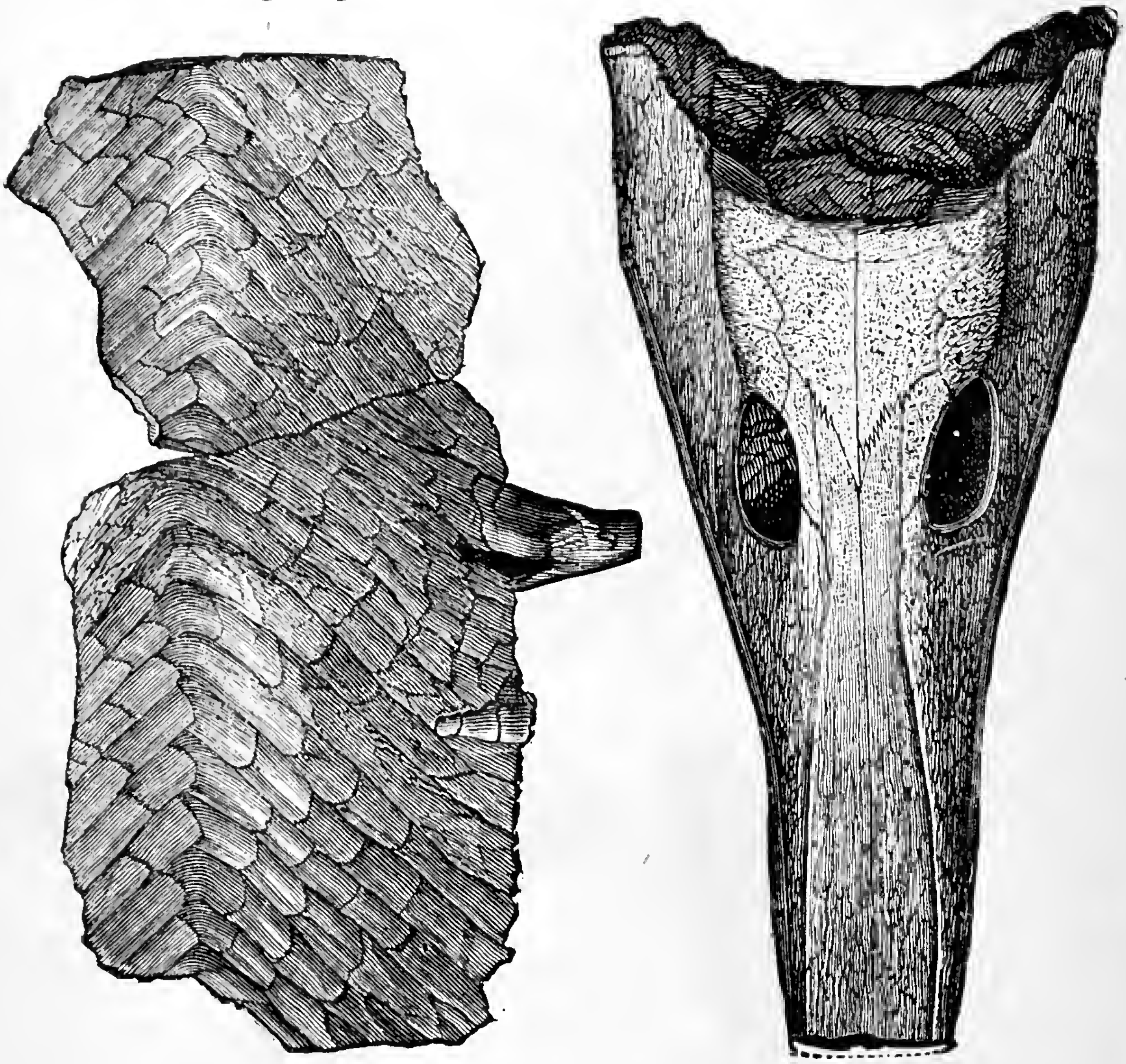
In the Diplospondylidæ the vertebræ, at least in the caudal region, consist of an anterior centrum carrying the neural arch, and a posterior intercentrum to which the chevrons are united; these intercentra correspond with those of *Clepsydrops* among the Anomodontia. This type of structure being known as *embolomerous*.

In *Cricotus* the skull is long and triangular with a narrow muzzle, and the ovoid orbits are situated in the hinder half; the cranial bones are sculptured; the vertebral bodies are perforated; the tail long and the body protected by scutes. (This is not at present represented in the Collection.)

In the Archægosauridæ each vertebra of the trunk, in *Trimerorachis* and *Archægosaurus*, consists of four portions,* namely, a basal intercentrum (hypocentrum), a pair of pleurocentra, and a neural arch. This is known as the *rhachitomous* type of vertebra. These are Labyrinthodonts of moderate size, having cylindrical teeth of varying size with only slight infoldings of **Wall-case, No. 11.**

* *See* Fig. 92, infra, p. 69; vertebra of *Euchirosaurus*, illustrating this rhachitomous type of vertebra.

the dentine; the upper surface of the skull being pitted; the supra-occipitals ridged; a ring of bones is usually developed in the sclerotic; the ventral surface of the body is always covered with scutes. This family is evidently the most primitive one of the entire group.



A B

FIG. 90.—*Cricotus heteroclitus* (Cope).—Ventral scutes (A), and frontal aspect of the cranium (B): from the reputed Permian of Texas. ½. (*After Cope.*)

Wall-case, No. 11.

The genus *Archægosaurus*, represented by *A. Decheni* (Goldfuss), from the Lower Permian "Rothliegendes" of Saarbrück, Rhenish Prussia, is particularly well represented in the Collection by a remarkably good series of examples. This genus is confined to the Permian formation, and may be taken as the type of the family. The skull is nearly twice as long as it is broad, with elongate-oval orbits, and situated very-far back; length of skull 11 inches.

Platyoposaurus is closely allied in cranial characters to *Archægosaurus*, but the infoldings of the teeth are sinuous instead of straight, and the orbits are more rounded. This genus is found in the Permian (Zechstein) of Russia.

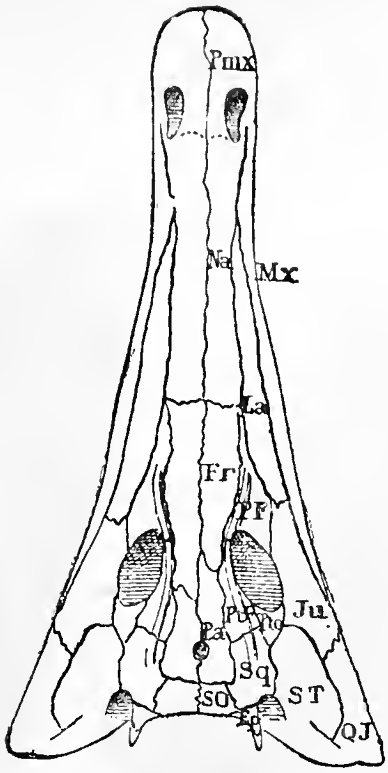


FIG 91.—*Archægosaurus Decheni* (Goldfuss).—Frontal aspect of the cranium, with the sculpture omitted; from the Rothliegendes (Lower Permian) of Saarbrück. About $\frac{1}{4}$. *Pmx*, premaxilla; *Mx*, maxilla; *Na*, nasal; *La*, lachrymal; *Fr*, frontal; *PF*, prefrontal; *Pa*, parietal; *Ptf*, postfrontal; *PtO*, post-orbital; *Ju*, jugal; *QJ*, quadratojugal; *Sq*, squamosal; *ST*, supratemporal; *Ep*, epiotic; *SO*, supraoccipital. (*After Miall*)

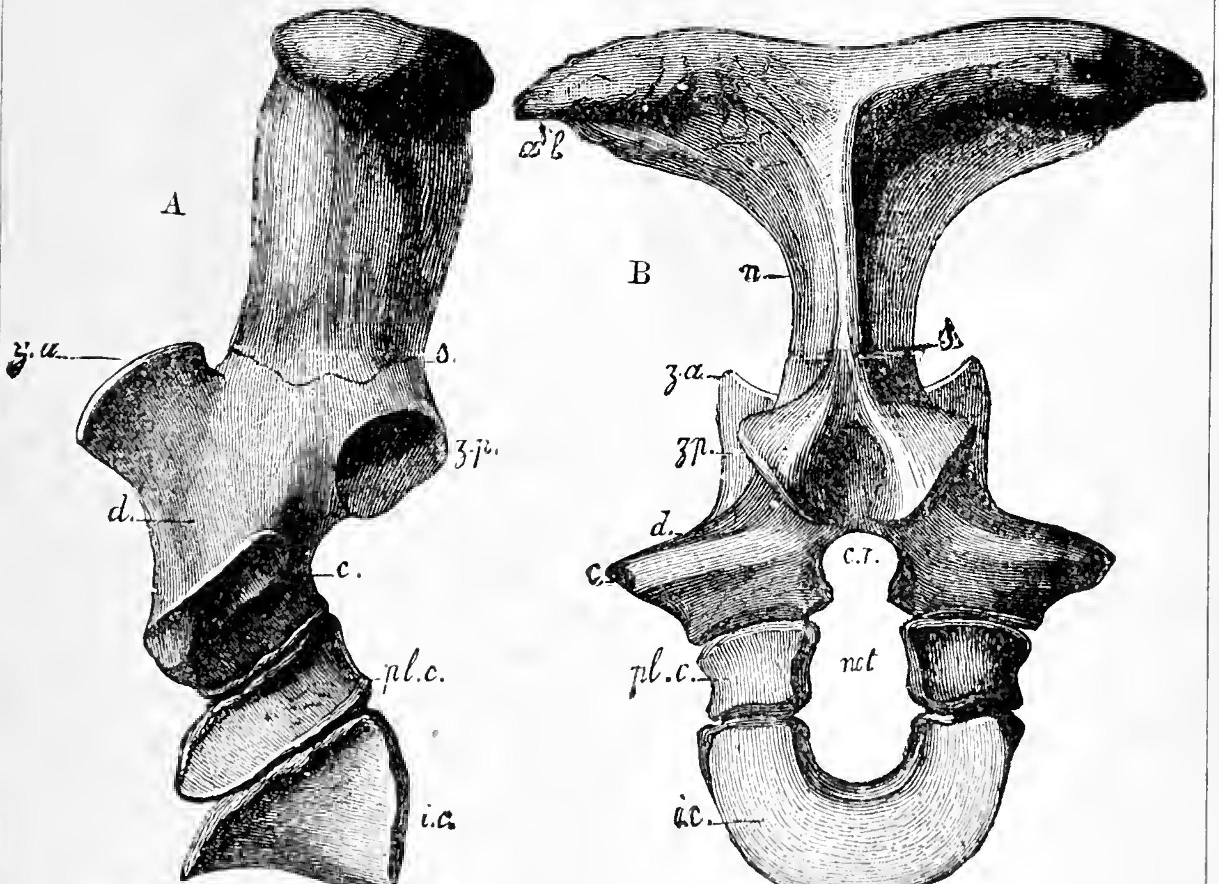


FIG. 92.—A, Left lateral aspect; B, posterior aspect of a vertebra of *Euchirosaurus Rochei* (Gaudry), from the Lower Permian of France. *n*, Neural spine with lateral expansions, *al*; *s*, suture between spine and arch; *za*, prezygapophysis; *zp*, postzygapophysis; *d*, transverse process; *c*, rib facet; *cr*, neural canal; *ic*, intercentrum; *plc*, pleurocentra (illustrating the rhachitomous type of vertebra). (*After Prof. Gaudry.*)

Wall-case, No. 11.

In *Actinodon* the skull is short and wide, with the circular orbits placed in the middle of the length; the nostrils are large and widely separated, the muzzle is broad. A skull of this species is preserved in the Collection on a slab of shale from the Lower Permian of Autun, Saône et Loire, France, and a cast of an entire skeleton from the same locality, presented by Prof. A. Gaudry, is exhibited in the Wall-case (Fig. 93).

Fig. 93.—*Actinodon latirostris* (Jordan, sp.).—Frontal aspect of the cranium, with the sculpture omitted; from the Lower Permian of Saarbrück. $\frac{2}{3}$ *Pt.F.*, postfrontal; *Pmx*, premaxilla; other letters as in Fig. 84 (p. 64).

Cochleosaurus, *Gaudrya*, *Chelyosaurus*, and *Sparagmites*, are Labyrinthodonts from the Permian Gas-coal of Bohemia, discovered and described by Dr. Fritsch, of Prague. *Trimerorhachis* is from the Permian of Texas. *Eryops* occurs in Texas, and also in South Africa. *Rhytidosteus* is from the Orange Free State, and *Pholidogaster* from the Lower Carboniferous of Edinburgh.

Sub-order 1.—Microsauria.

Wall-case, No. 11.
Table-case, No. 23.

This sub-order contains a number of salamander-like forms of Labyrinthodonts referred to the family Urocordylidæ, and to the genera *Urocordylus*, *Ceraterpetum*, *Lepterpetum*, from Kilkenny, Ireland, and from Bohemia. *Limnerpetum*, from Bohemia, occupies a family by itself. The Hylonomidæ include *Hylonomus*, *Seeleya*, *Ricnodon*, *Orthopleurosaurus*, all from the Gas-coal of Bohemia. *Microbrachis*, also from Nyran, Bohemia, occupies a distinct family. Most of these are represented by electrotypes of the original fossils.

SUB-ORDER **Aistopoda.**

In this sub-order the body is snake-like without legs, and there is neither a pectoral nor pelvic girdle; the centra of the vertebræ are elongated, and the neural spines aborted. It includes *Dolichosoma* and *Ophiderpetum* (Huxley) from the coal of Ireland and the Permian of Bohemia. **Wall-case, No. 11. Table-case No. 23.**

SUB-ORDER **Branchiosauria.**

These are short-tailed salamander-like Labyrinthodonts with barrel-shaped centra, and a notochordal canal through their vertebræ.

The family APATEONIDÆ includes *Melanerpetum* from Bohemia; and the family PROTRITONIDÆ the genera *Protriton* of Gaudry from the Lower Permian of Autun, and Bohemia; *Sparodus* and *Dawsonia* also from the last-named locality. **Table-case, No. 24. Wall-case, No. 11.**

Among doubtful Labyrinthodonts may be recorded here, *Lepidotosaurus Duffii* from the M. Permian of Midderidge, Durham. Some of the *Ichnites* (Footprints) were doubtless made by Amphibians; they are mentioned under that head in Gallery No. 11. (see *infra*, p. 98 of this Guide, Fig. 94).

GALLERIES RUNNING NORTH FROM THE REPTILIAN GALLERY.

There are seven Galleries running at right angles to the Reptilian Gallery (*see* Plan facing p. 108), about 140 feet in length; three of which are forty feet in breadth, and four are of half that width. The first narrow gallery is occupied by the General Library.

Class V.—PISCES (Fishes).*

Fossil Fishes.

Gallery No. 6 on Plan.

The first wide Gallery (No. 6, on Plan), is devoted to the exhibition of the Fossil Fishes, and contains thirty-two Table-cases, and about 260 feet linear of Wall-cases.

Here are exhibited the finest collection of Fossil Fishes ever brought together in any museum. This class was always well represented, but it has lately received two splendid additions by the acquisition of the famous collection of the Earl of Enniskillen, from Florence Court, Ireland; and that of the late Sir Philip de Malpas Grey-Egerton, Bart., M.P. (Trustee of the British Museum), of Oulton Park, Tarporley, Cheshire; both obtained in 1882.

Orders I., II.—PLAGIOSTOMI and CHIMÆROIDEI.

Wall-cases. Nos. 1, 2, and 3.

Wall-cases Nos. 1, 2, and 3 are entirely occupied with the Plagiostomatous fishes (sharks and rays); the specimens exhibited comprise a very large series of "Ichthyodorulites" (fish spines) followed by the *Hybodontidæ*, *Cestraciontidæ*, and more modern families of the Order.

The "Ichthyodorulites" include spines of *Gyracanthus* and *Ctenacanthus*, from the Upper and Lower Carboniferous, and *Oracanthus*, etc., from the Carboniferous limestone. To these succeeds a fine series of remains of heads with teeth, spines, and the "shagreen" skin of *Hybodus* and *Acrodus*, from the Lias of Lyme Regis. Many of these show also the curious recurved dermal spines, named *Sphenonchus* by Agassiz, who constituted a distinct genus for their reception. There are two on each side of the head, one near the posterior border of the orbit, and the second a little further backward.

Wall-case No. 3 is devoted to the remaining Selachians, the most noteworthy of which are the well preserved sharks and rays from the Cretaceous formation of the Lebanon. The case also contains several specimens of Chimæroids, including the very singular fish named *Squaloraja polyspondyla*, from the

* *See* also separate Illustrated "Guide to the Fossil Fishes."

Lias of Lyme Regis. On the adjoining pillar a large example of an extinct ray, *Rhinobatus bugesiacus*, from the Lithographic stone of Bavaria, is exhibited; and there are other smaller specimens, from a corresponding formation near Lyons, in the case.

Gallery, No. 6. Fossil Fishes. Wall-case, No. 3.

The first nine Table-cases on the West side of Gallery A. are also devoted to the *Plagiostomi*, and *Chimæroidei*, comprising the *Carchariidæ*, *Lamnidæ*, *Notidanidæ*, *Hybodontidæ*, *Cestraciontidæ*, *Myliobatidæ*, *Raiidæ*, *Torpedinidæ*, *Squatinidæ*, *Pleuracanthidæ*, and the *Edaphodontidæ*, whose modern representatives, the sharks, rays, and chimæras, are most widely distributed in the seas of to-day.

Sharks, Rays, and Chimæras. Table-cases, Nos. 25 to 34.

There is great difficulty in obtaining satisfactory evidence for the correct determination of these cartilaginous fishes in a fossil state. Thus in the sharks we have only the spines, teeth, and shagreen left: all else has disappeared, save some few of the vertebræ in the Chalk and London Clay; the backbone of the earlier sharks appears to have been quite "notochordal." Even the spines and teeth are not always found in association in the same deposit, so that one cannot with certainty affirm that they belonged to the same fish. In many instances teeth and spines, originally placed in separate genera, have now been determined by correlation to belong to the same fish. Thus for example:—The spines named *Pleuracanthus*, from the Coal Measures, belong to the teeth called *Diplodus*, from the same beds. *Asteracanthus* spines found with *Strophodus* teeth are evidently parts of the same fish; while *Leptacanthus* spines, found in the same matrix with Chimæroid jaws, in the Chalk, the Stonesfield Slate, and in the Solenhofen stone, furnish conclusive evidence of their union in the same fish. There can be no doubt that *Myriacanthus* spines in like manner belonged to extinct genera of chimæras. The teeth and spines of both *Acrodus* and *Hybodus* have now each been found in their true association, so that we know certainly the forms belonging to each genus. Again, many forms of crushing teeth which had been made into distinct species, are now known to occur in the jaws of the same fish. Thus the teeth named *Strophodus magnus*, and others named *favosus*, may be seen in the mandible of the same individual.

Teeth and Spines of Sharks.

Acrodus and Hybodus.

The wide distribution, both geographically and geologically, of the sharks is very remarkable. Teeth of the genus *Carcharodon* have been met with in Tertiary deposits in New Zealand, Jamaica, Carolina, Malta, Egypt, in the Antwerp and Suffolk Crags, and elsewhere: and several species of other genera are found common to the lower Tertiaries both of Europe, America, and Australia. Sharks' teeth were also dredged up, in numerous localities, from the bed of the ocean during the voyage of H.M.S. *Challenger*, so that teeth of sharks will form a marked feature in the deposits now in process of formation in the depths of the sea.

Carcharodon.

Fossil Fishes.

Order III.—DIPNOI.

Gallery, No. 6.

Wall-case, No. 5. Table-case, No. 36.

The DIPNOI form a very peculiar order of fishes, having a a notochordal skeleton. To it belong the living *Protopterus*, *Lepidosiren*, and *Ceratodus*. Teeth, indistinguishable in character from the modern *Ceratodus*, are abundant in the Trias, Rhætic, and Oolitic formations. *Dipterus* occurs in the Devonian, *Ctenodus* in the Carboniferous. Several other genera are also represented.

Order IV.—GANOIDEI.

Wall-case, No. 4.

In Wall-case No. 4 follow the Acanthodians, represented by *Cheiracanthus*, from the Lower Old Red Sandstone of Lethen Bar and Tynet Burn, and from the equivalent beds of Forfarshire. To these succeed the Placoderms *(Pterichthys, Coccosteus, Asterolepis)*, and in Table-cases Nos. 34, 35, are placed many of the smaller Acanthodians, and the *Cephalaspidæ* (*Cephalaspis*, *Scaphaspis*, *Pteraspis*, &c.), from the Scottish Old Red, and from Herefordshire. Two fine reproductions of the shield of the Placoderm *Homosteus* are also placed on the pillar between Wall-cases Nos. 4 and 5. The original specimens were obtained from the Lower Old Red Sandstone of Caithness, and are now in the Edinburgh Museum.

Table-case, No. 35.

Wall-cases, Nos. 5 to 7.

In Wall-cases 5—15 are arranged the true fishes of the order GANOIDEI. The first sub-order (CROSSOPTERYGII) occupies cases 5 to 7, and embraces the *Holoptychiidæ (Holoptychius, Glyptolepis)*; *Rhizodontidæ (Tristichopterus* and *Gyroptychius* from the Old Red Sandstone, and *Rhizodus* from the Lower Carboniferous of Scotland); the *Saurodipteridæ (Osteolepis* and *Diplopterus*, from the Old Red Sandstone, and *Megalichthys* from the Carboniferous); and lastly, the *Cœlacanthidæ*, remarkable for their long range in geological time *(Cœlacanthus* occurring in the Carboniferous and Permian, *Holophagus* in the Lias, *Undina* in the Oolites, and *Macropoma* in the Chalk).

Wall-case, No. 8. Table-cases, No. 37-39.

Wall-case 8, and a portion of No. 7, contain remains of the second sub-order of Ganoids, the ACIPENSEROIDEI. These are represented by the true Sturgeons *(Acipenser)* from the London Clay of Sheppey; by *Chondrosteus* and *Gyrosteus* from the Lias, by the *Palæoniscidæ*, including *Chirolepis*, *Pygopterus*, *Acrolepis*, and *Oxygnathus*, from the Old Red Sandstone to the Lias inclusive, followed by the *Platysomidæ*, represented by the genus *Platysomus*.

Wall-cases, Nos. 9 to 14

Wall-cases Nos. 9 to 14 comprise all the genera included in the great sub-order of the LEPIDOSTEOIDEI (fishes with rhomboidal scales) represented by the genera *Eugnathus*, *Lepidotus*, *Heterolepidotus*, *Dapedius*, *Pholidophorus*, *Semionotus*, *Aspidorhynchus*, *Gyrodus*, &c.

Wall-case, No. 15.

In Wall-case No. 15 are placed the fossil fishes of the sub-

order Amioidei, represented by the genera *Caturus*, *Leptolepis*, *Thrissops*, &c.

Order V.—TELEOSTEI.

The remaining Wall-cases (Nos. 16—18) contain the order of Teleostei (fishes with a well-developed, bony skeleton). The *Esocidæ* (the pike), *Clupeidæ* (the herrings), and *Salmonidæ* (the salmon and trout), including the genera *Esox*, *Clupea*, *Osmeroides*, with the *Percidæ* (or perches), *Perca*, *Smerdis*, &c. **Fossil Fishes. Gallery, No. 6. Wall-cases, Nos. 16 to 18.**

Wall-cases Nos. 17 and 18 contain the Cretaceous, spiny-finned fishes of the genera *Beryx* and *Hoplopteryx*, and the Eocene fishes from the Canton Glaris slates, of the genus *Anenchelum*, &c., together with the *Percidæ* (perch family), and the curious thread-fin, *Gastronemus*, from Monte Bolca. **Wall-cases, Nos. 17 and 18.**

The Table-cases follow the same arrangement as is observable in the Wall-cases, varied only by the size and number of the specimens by which each family is represented. **Table-cases, Nos. 49 to 56.**

This terminates the series of Vertebrate fossils, and in the next Gallery we commence with the Invertebrata (animals without a backbone)—such as Cuttlefishes, Snails, Oysters, Insects, Crabs and Lobsters, Worms, Sea-urchins, Corals, &c.

Invertebrate Animals.

Sub-Kingdom 1.—Mollusca (Soft-bodied animals).

Division A.—Mollusca (proper).

Class 1.—Cephalopoda.

In Narrow Gallery (No. 7 on Plan) are displayed the fossil Cephalopoda,* being the first section of the Invertebrate animals and the highest division of the Molluscan Class. **Mollusca. Cephalopoda.**

The animals of this class are all marine, and are provided with long feelers or tentacles (sometimes called feet) attached to the head around the mouth, whence the name Cephalopoda, or "head-footed," is derived. Here are placed the fossil representatives of the existing *Octopus*, and the Squids and Cuttle-fishes, the delicate Paper Nautilus and *Spirula*, also the Pearly Nautilus. These are divided into two great groups, the *Dibranchiata*, or two-gilled, and the *Tetrabranchiata*, or four-gilled Cephalopods. **Gallery, No. 7 on Plan.**

The first of these includes the most active free-swimming forms to which all the living genera belong. One solitary form, a survivor of the second or Tetrabranchiate division, namely "the Pearly Nautilus," is still found living in the Indian Ocean.

* From κεφαλή, head, and πους, ποδος, a foot; hence "head-footed."

Gallery, No. 7 on Plan.

Most of them have a delicate internal shell, often quite minute, or rudimentary, as in *Octopus*, or divided into chambers by septa or partitions, as in *Spirula*.

Cephalopoda.

Wall-case, No. 1. Table-case, No. 58.

The delicate shells of *Spirulirostra*, *Beloptera*, &c. (Table-case, No. 58), occur in the Miocene and Eocene Strata. Impressions of "Squids" showing the soft parts of the body, the arms, and the "ink-bag" are found in the Chalk of the Lebanon, Syria; the Oxford Clay of Wiltshire; the Solenhofen limestone of Bavaria; and the Lias of Lyme Regis, &c. (Table-case, No. 58; Wall-case, No. 1).

Belemnites.

Wall-case, No. 14. Table-case, No. 58.

The "Belemnite," so common a fossil in the Cretaceous and Oolitic rocks, is only the shelly extremity or "guard" (like the tip of a spear, or dart, without barbs), forming part of the internal shell of an extinct kind of Squid, or Cuttlefish, which, when perfect, had a chambered upper portion to its shell (called the *phragmocone*), and a pearly extension beyond (called the *pro-ostracum*). Some nearly perfect examples have been found in the Lias and Oxford Clay (*see* Wall-case). The arms were provided with hooklets as well as suckers for holding fast its prey, and each animal had an ink-bag that secreted an inky fluid (known as sepia, and used as a pigment by artists), which could be ejected into the water at pleasure, so as to conceal the animal's retreat by a cloud of inky blackness (Wall-case, No. 14, and Table-case, No. 58).

Ink-bag of the Cuttle (Sepia).

Beaks of Cuttle-fishes.

They all had strong horny or shelly mandibles, resembling a parrot's beak; these are frequently met with in a fossil state.

By far the largest proportion of the fossil forms, however, belong to the Tetrabranchiate, or four-gilled division, represented at the present day by the "Pearly Nautilus" of the Indian Ocean. These were less active forms than the Squids and Cuttlefishes; and instead of having, like them, an internal shell, they had a strong external one with a pearly lining, in the large body-chamber of which the soft parts of the animal was enclosed. The rest of the shell is divided by septa or partitions into a series of chambers usually filled with fluid, through which a tube passes called the "siphuncle." These are merely the earlier and disused chambers of the animal's shell which had been inhabited when it was younger, and have been gradually closed off and abandoned as the increased growth of its soft parts required a larger habitation.

Turrilites, Baculites, etc.

All the beautiful and varied forms of *Turrilites*, *Baculites*, *Ammonites*, *Ceratites*, *Goniatites*, *Orthoceratites*, &c., belong to this great division of the Cephalopoda.

The shells of the Pearly Nautilus have been obtained in large numbers from the London Clay of Highgate, Hampstead, and the Isle of Sheppy. Beautiful examples of these and of the little *Nautilus* (*Aturia*) *zic-zac* may be seen in the Table and Wall-cases. The Ammonites in infinite variety of pattern

occur from the close of the Cretaceous period to the base of the Secondary rocks; followed by *Ceratites* in the Trias, and *Goniatites* in the Carboniferous formation, their variations in form and in ornament being only modifications of the shells of the same family.

Mollusca. Gallery, No. 7.

The older forms chiefly belong to the straight *Orthoceratites*, having shells like a Nautilus but uncurled and straightened out, or to curious forms, having various degrees of curvature in the shell, between the straight Orthoceras and the involute Nautilus and Ammonite. These variations are also found in many genera of Cephalopod Shells of the Chalk period. A fuller description of the contents of this Gallery will be given in a small separate Guide in preparation, which will be issued as soon as the cases are completely arranged.

Cephalopoda. Orthoceras. Wall-case, No. 8.

Class 2.—**Pteropoda** (Wing-shells).

A single Table-case is devoted to this curious division of Mollusca, represented at the present day by small oceanic animals, whose entire life is passed in the open sea far away from any land, swimming by means of two wing-like appendages, one on each side of the head. The Pteropods had their representatives far back in past geological time.

Pteropoda. Gallery, No. 7 on Plan. Table-case, No. 72.

In the Miocene beds of Bordeaux, Dax, Turin, Sicily, and in the Suffolk Crag, small delicate shells occur, like the existing genera—*Hyalea, Vaginella, Cuvieria;* whilst in the Carboniferous, Devonian, and Silurian many species are met with, as *Conularia, Hyolithes (Theca)*, &c., which attained a large size compared with the minute shells of living members of this class.

Gallery (No. 8 on Plan).—The second of the wide Galleries has thirty-two Table-cases, and Wall-cases corresponding with Gallery No. 6. In it are placed the remaining groups of the Mollusca, viz., the Gasteropoda, the Lamellibranchiata, and the Brachiopoda. It also contains the Polyzoa, the Insecta and Crustacea, the Annelida, and Echinodermata.

Class 3.—**Gasteropoda** (Snails, Whelks, &c.).

Class 4.—**Lamellibranchiata*** (Oysters, Cockles, &c.).

The fossil shells of the above groups occupy the whole of the West or left side of this Gallery and a small portion of the East or right side. Wall-cases Nos. 1 to 9 contain the Foreign Mollusca, and Table-cases Nos. 89 to 104 the British specimens of the same group. The Gasteropods, or Univalves, are placed first in each case, and the Lamellibranchs, or Bivalves, follow them. The whole series is subordinately arranged in strati-

Gallery, No. 8 on Plan. Wall cases, Nos. 1 to 9. Table-cases Nos. 89 to 104.

* Called also *Pelecypoda*, by Goldfuss (1820).

Mollusca. Gallery, No. 8 on Plan. West side.

graphical order, commencing with the most recent deposits, such as the Peat, Raised-Beaches, Glacial deposits, and going back in time to the Silurian and Cambrian periods.

Wall-cases, Nos. 1, 2, 3, and 4. Table-cases, Nos. 100 and 101.

Attention is drawn to the fine series of Mollusca from the French, Italian, and English Tertiary strata, particularly to the beautiful collection of shells from the Eocene strata of the Paris Basin (Wall-cases Nos. 3 and 4), and the Miocene of Bordeaux (Wall-cases Nos. 1, 2, and 3), to our own Eocene shells from Highgate, Bracklesham, Barton, and the Isle of Wight (*see* Table-cases Nos. 100, 101). This Molluscan fauna of the South-east of England indicates the former existence of a much warmer climate in Britain than we now experience; for such genera as *Conus* and *Voluta*, then so abundant, do not now live on our coasts, but must be sought for in subtropical seas.

Cerithium giganteum.

A fine specimen of *Cerithium giganteum* from the Eocene of the Paris Basin is placed under a glass-case between Wall-cases 3 and 4. In the centre of this Gallery is placed a fine slab of "Petworth Marble," entirely composed of the shells of a fresh-water snail *Vivipara (Paludina) fluviorum*, Sby. The elegant columns of the Temple Church, Fleet Street, are made of this marble from the Weald of Sussex.

Wall-cases, Nos. 5 and 6.

In Wall-cases Nos. 5 and 6 are placed the curious shells called *Hippurites*, allied to the existing Chamas. They probably lived clustered in Coral-reefs like their modern representatives. They are seldom met with in the Cretaceous rocks of this country, but the "Hippurite limestone" is largely developed on the Continent, in France, Spain, and Italy; it also occurs in the East and West Indies.

Table-case, No. 93. Wall-case, No. 7. Table-cases, Nos. 92 to 98.

Among the Oolitic and Cretaceous Mollusca may be noticed the shells of three genera, rarely obtained living in the seas of to-day, namely, *Pleurotomaria* (Table-case No. 93 and Wall-case No. 7), *Pholadomya* and *Trigonia* (Table-cases Nos. 92 to 98). Only four recent species of *Pleurotomaria*, represented by 13 specimens, have been obtained. As many as 1,156 species are recorded fossil, ranging from the Tertiaries to the Silurian formation, but mostly found in the Oolitic and older rocks. A single living species of *Pholadomya* is known from the West Indies; whilst *Trigonia* only occurs in the seas of Australia.

Division B.—Molluscoida.

Gallery, No. 8. East side.

Class 5.—**Brachiopoda** ("Lamp-shells," ex. *Terebratula*).

Table-cases, Nos. 85, 86, 87, and 88.

The British collection of Brachiopods, or "Lamp-shells," occupies Table-cases Nos. 85, 86, 87, and 88. The Tertiary, Cretaceous, Oolitic, Carboniferous, and Devonian forms being

well represented, also those of the Upper and Lower Silurian strata. **Gallery, No. 8 on plan, East side.**

The foreign species occupy Wall-cases Nos. 10 and 11. The Brachiopoda were most carefully studied by the late Mr. Thomas Davidson, LL.D., F.R.S., who devoted his whole life to the illustration and description of this class of the Mollusca. Many of the specimens figured by him may be seen in the cases. In 1886 he bequeathed his entire collection to the Nation, and it is exhibited in Gallery No. 11. **Wall-cases, Nos. 10 and 11.**

Class 6.—**Polyzoa** (Sea-mats and horny Corallines).

These elegant organisms, so frequently found upon the sea-shore, and often confounded with sea-weeds (Algæ), are really the horny or calcareous composite habitations of numerous distinct but similar microscopic zoöids, each individual occupying a minute double-walled sac, in a common habitation, called a *cœnœcium*. **Table-case, No. 84. Wall-case, No. 12.**

They are met with in great variety of form in the Coralline Crag of Suffolk, in the Miocene of Dax, Bordeaux, and Touraine, and more rarely in the Eocene beds of the London and Paris Basin.

Beautiful masses of *Fenestella* are found in the Permian or Magnesian Limestone of Durham, and in the Permo-Carboniferous rocks of Australia and Tasmania. The Polyzoa of the Carboniferous formation are also numerous and varied. The most singular of these is the *Archimedipora*, which has its *cœnœcium*, or *polyzoarium*, arranged around a central screw-like axis, giving it a most elegant geometrical form.

Sub-Kingdom 2.—Annulosa.

Division A.—Arthropoda (Jointed Animals).

Class 7.—**Insecta** (ex. Beetles, Flies, Bees, &c.).

„ 8.—**Myriapoda** (ex. Centipedes, Millipedes).

„ 9.—**Arachnida** (ex. Spiders, Scorpions, &c.).

Insects, Myriapods, and Arachnida are very rare in the rock-formations of this country. They have, however, been met with in considerable numbers in the Eocene strata of Gurnet Bay, Isle of Wight, in the Purbeck Beds of Swanage, Dorset, in the Great Oolite of Stonesfield, the Lias of Warwickshire, the Coal Measures of Coalbrook-dale, and Scotland, &c. (*see* Table-case No. 84). They are more abundant in the Brown Coal of Bonn; in the Amber from the Miocene Beds of Samland on the Baltic; from Œningen, near Constance; and from the Litho- **Insects.** **Table-case, No. 84.**

Gallery, No. 8. Insects. See Wall-case, No. 12.

graphic stone of Solenhofen, Bavaria. From the last-named locality beautiful Dragon-flies (*Libellulæ*) and numerous other genera have been obtained (*see* Wall-case No. 12).

Crustacea.

CLASS 10.—**Crustacea** (ex. Crabs and Lobsters).

Wall-cases, Nos. 12, 13, and 14,

Table-cases, Nos. 80 to 83.

Table-case, No. 80.

The Foreign Crustacea occupy Wall-cases Nos. 12, 13, and 14, and the British forms fill four-and-a-half of the adjoining Table-cases, Nos. 80 to 83. Those British specimens too large for the Table-cases are arranged on the top shelf of the Wall-cases. Attention is directed to Table-case No. 80, in which is exhibited a fine series of Trilobites from the Wenlock shale and limestone near Dudley. Many of these Silurian Crustaceans are remarkable for great beauty and variety of form, and exhibit in some instances (as in *Phacops*) the singular compound eyes, peculiar to the Arthropoda; and in *Encrinurus*, the eyes placed upon long eyestalks.

Wall-case, No. 14b.

See Wall-case, No. 13.

The largest of the British Trilobites (*Paradoxides*) exceeds 2 feet in length (*see* Wall-case No. 14 B), whilst the nearly-allied genus *Pterygotus*, from the Old Red Sandstone of Forfarshire, measured fully 5 feet in length (*see* Wall-case 13).

Other specimens of this class are fixed on the Wall adjoining.

DIVISION B.—ANARTHROPODA.

CLASS 11.—**Annelida** (ex. Earth-worms, Sand-worms, Tube-worms, &c.)

Table-case, No. 79, and Wall-case, No. 15.

Sea-worms (Table-case No. 79 and Wall-case No. 15), being soft-bodied animals, are seldom preserved in a fossil state; but their existence is proved by the tracks, burrows, and worm-castings which they have left on the wet mud, and upon the ripple-marked sands of the old sea-shores, before these had become hardened into shales and sandstones; their microscopic teeth have also been found as fossils in the Lower Palæozoic rocks.* Some species form shelly tubes,† and these are frequently found in rocks both of Palæozoic and Secondary age.

Sub-Kingdom 3.—ECHINODERMATA (Spiny-skinned Animals).

Division A. ECHINOZOA.	Division B. PELMATOZOA.
Class 12. **Echinoidea** (Sea-urchins).	Class 16. **Crinoidea** (Stone-lilies).
„ 13. **Asteroidea** (Star-fishes).	„ 17. **Cystoidea.**
„ 14. **Ophiuroidea** (Brittle-stars).	„ 18. **Blastoidea.**
„ 15. **Holothuroidea.**	

* See an account of these with figures by Dr. G. J. Hinde, F.G.S., "Quart. Journ." Geol. Soc., Lond., 1879.

† These worms are called "Tubicolar Annelids," or Tube-worms.

The animals grouped in this division are very different in appearance, but agree in having their soft parts enclosed within a more or less solid calcareous covering, composed of numerous plates, disposed usually in a distinctly radial arrangement. **Gallery, No. 8 on Plan, East side.**

1. This radial structure is particularly observable in the Sea-urchins *(Echinoidea)*, whose tests, of marvellous beauty and variety of form, are, when living, covered with rows of moveable spines, which serve as defences, and aid the ambulacral tubes or suckers in locomotion. The spines, which are calcareous, vary greatly in length and form, being often very minute, but sometimes of great thickness, or of extraordinary length. Many examples of these are exhibited. Some of the largest of the fossil Sea-urchins, called *Clypeaster*, are from the quarries of Mokattam, near Cairo, whence the Nummulitic Stone, used in constructing the Pyramids, was quarried (Wall-case No. 15). The Echinoidea of our own Chalk and Oolite are placed in Table-cases Nos. 76-78. **Echinoidea, Sea-Urchins. Wall-case, No. 15. Table-cases, Nos. 76 to 78.**

2. Of the Star-fishes the magnificent series of *Pentagonaster* and *Pentaceros*, from the Chalk; the fine *Solaster Moretonis*, from the Great Oolite, with thirty-three arms; and the five-rayed *Stellaster Sharpii*, from the Northampton Ironstone, deserve special notice. (Table-case No. 76.) **Star-fishes. Table-case, No. 76.**

3. The "Brittle-stars," such as *Ophioderma Egertoni*, from the Lias of Lyme Regis, and others of Silurian age, resemble those now found living on our own coasts. (Table-case No. 75.) **Brittle-stars.**

4. The Stone-Lilies (Crinoidea), so rare in our modern seas, were once exceedingly abundant in the Secondary and Palæozoic periods. **Stone-lilies.**

They were fixed during life to the sea-bottom by means of a flexible stalk. The body was of variable shape, but covered by calcareous plates, and surmounted by branched arms from five to ten in number.

The most striking objects of this group are the Lily-encrinites *(Encrinus liliiformis)*, from the Muschelkalk of Brunswick (Wall-case No. 17); the Pear-encrinite *(Apiocrinus elegans)*, from the Bradford Clay, of Wiltshire (Table-case No. 74); the beautiful *Extracrinus Hiemeri*, from the Lias of Boll, Wurtemberg, and the *Extracrinus fossilis* from Lyme Regis, Dorset (Wall-case No. 16 and Table-case No. 74). **Wall-case, No. 17. Table-case, No. 75. Wall-case, No. 16, and Table-case, No. 74.**

Placed on the wall, near the case of Lias Pentacrinites, is a fine polished slab of "Entrochal or Encrinital marble," from Derbyshire, almost entirely composed of the broken stems of *Actinocrini* (Stone-lilies), from the Carboniferous limestone. The cases containing the older forms, from the Wenlock limestone (U. Silurian), near Dudley, are deserving of special notice; also the fine series of North American Carboniferous and Silurian genera (Wall-cases Nos. 17 and 18). **Wall-cases, Nos. 17 and 18.**

The curious and anomalous forms of *Cystoidea* and *Blastoidea*,

Gallery, No. 8.

from the Carboniferous and Silurian rocks, are very well represented here.

Holothuroidea; (sea-cucumbers).

5. The *Holothuroidea*, which have no hard test, properly so called, and in which the body is vermiform, have small plates and spicules scattered through the skin. Those of *Synapta* (shaped like microscopic anchors) and of *Chirodota* (like minute wheels) have been found by washing the decomposed shales of the Carboniferous limestone of the East of Scotland.

Narrow Gallery, No. 9 on Plan (*see* p. 108).—This is retained for study purposes, and contains also the Geological Library.

Gallery No. 10 on Plan.—This is the third of the wide Galleries, and contains upon its Western side:—

Sub-Kingdom 4.—Cœlenterata.

Class 19.—**Actinozoa** (Rayed Animals).

Gallery, No. 10 on Plan, West side.

Corals.

Wall-cases, Nos. 1-6.

Table-cases, Nos. 1-9.

This group embraces the "Sea Anemones," the *Alcyonaria*, and the true corals.

The Sea Anemones have no hard parts or skeleton, and are therefore unknown in a fossil state, but they serve admirably to exemplify by their soft parts the structure of the coral-polype.

The cylindrical body of the Sea Anemone is tough, flexible, and elastic, with a sucker-like expansion at the base, by which it attaches itself to rocks, &c. The mouth is placed on the summit, and is encircled by numerous flexible retractile tentacles, resembling when expanded the petals of a flower.

The mouth leads directly into the stomach, which opens below into the general visceral cavity. The space surrounding the stomach is divided into a number of compartments by a series of radiating vertical partitions known as the "mesenteries," which take their rise from the inner surface of the body wall, and are attached to the external surface of the stomach; they are also continued downwards to the base of the visceral cavity, although less largely developed.

The spaces between the mesenteries are connected with the general visceral cavity beneath the stomach.

Division A.—Zoantharia-sclerobasica.*

Alcyonaria.

In the *Alcyonaria* the polypes live together united by a common tissue (called the "cœnosarc"); each polype has eight

* *Sclerobasica* from *skleros*, hard, and *basis*, a pedestal: applied to a coral having a solid axis which is invested by the soft parts of the animal.

tentacles, and closely resembles in its structure a minute Sea Anemone. They are supported by an internal horny or calcareous skeleton or axis, secreted by the common flesh (or cœnosarc), and over which it is spread, like the bark enclosing the wood of a tree.

Gallery, No. 10.

Corals.

Table-cases, Nos. 1, 5, 6, 8 & 9, and Wall-cases, Nos. 1 to 6.

The "Red Coral" (*Corallium rubrum*), the *Isis*, the *Gorgonia*, and the *Tubipora* belong to this division.

The Alcyonaria occupy a part of Table-cases Nos. 1, 5, 6, 8, and 9, and of Wall-cases Nos. 1–6.

Division B.—Zoantharia-Sclerodermata.*

Wall-cases, Nos. 1 to 5. Table-cases, Nos. 1 to 8.

A simple Coral.

In the true Corals the animal itself resembles a Sea Anemone, but instead of the polype being entirely composed of soft tissues, a deposit of solid calcareous matter is formed by the secretion of Carbonate of Lime by the outer surface of the ectoderm of the polype. Commencing at the base, it grows up and forms a more or less cup-shaped external wall or *theca* around the polype. From this wall are developed numerous perpendicular plates, the *septa*, which converge inwards; they correspond with the mesenteries. The number of septa and of the mesenteries and tentacles increases regularly with the age of the polype.

In addition to the *theca* and the *septa*, a column-like calcareous mass sometimes arises in the axis of the cup, and is known as the *columella*, and near it a circle of calcareous rods, called *pali*, which are more or less separate from the *septa*. Furthermore, there are sometimes formed, between the lateral surfaces of the septa, interseptal rods or horizontal shelves (termed *dissepiments*). Of this nature also are the *synapticulæ* and *tabulæ*; the former are transverse calcareous bars, uniting the opposite faces of adjacent septa: the latter are highly developed dissepiments, and, like them, are as a rule horizontal; they often form transverse plates right across the visceral chamber. The *epitheca* is an additional calcareous investment, strengthening the external wall or *theca* of the polype. *Costæ* or ribs may also project from the outer wall of the cup. Within the calice or cup are placed the stomach and soft parts of the polype and the visceral chamber; below this the calice is sub-divided by the septa into a number of vertical compartments, called "the *interseptal loculi*."

The septa are not all of equal length; some, called *primary septa*, are wider than others, and may extend far enough to meet in the centre of the visceral chamber; others are less produced, and are known as secondary and tertiary septa, according to their width.

* "Hard-skinned Corals," that is to say polypes, which secrete a calcareous skeleton or corallum.

Gallery, No. 10.

Corals.

Wall-cases, Nos. 1 to 5, and Table-cases. Nos. 1 to 8.

The number of the septa varies in the several divisions; thus in the Aporosa and Perforata they are in six, or multiples of six, whilst in the Rugosa there are usually four primary septa.

Compound Corals.

Having briefly described a simple coral polype with its *theca*, or external wall, its *septa* corresponding to the mesenteries of the sea anemone, we can better understand an *aggregate coral*, built up by a large number of these simple polypes growing together and uniting their separate calcareous skeletons so as to form a compound corallum. The colony may consist of a number of individuals, all springing directly from one another, or they may be united by a common flesh or "cœnosarc." This cœnosarc secretes a common calcareous basis or tissue, which unites the several corallites together, called the *cœnenchyma*. Some coral polypes increase their mass by *lateral gemmation*, or budding from the sides; others from the base by root-like prolongations; or new individuals are developed by budding *within the cup* of the parent polype (known as *calicular gemmation*), as in the genera *Lonsdaleia*, *Goniophyllum*, &c.; whilst others increase by fission of the parent polypes themselves.

All the living *Zoantharia sclerodermata** inhabit the sea, and no doubt all the fossil corals were also marine. They attain their maximum development at the present day in the warmer seas of the globe, so that their abundant presence in any formation may be accepted as good evidence of the former existence of a warm temperature in the sea of that period. Two distinct types of corals exist at the present day, namely, those which inhabit tolerably deep water, and those which build the great masses of corals which are known as "coral-reefs." The deep-sea corals often attain, as individuals, considerable size; they also grow as compound masses, but never form those massive aggregations known as "reefs." Deep-sea corals appear to have existed in all the great geological periods, from the Ordovician upwards. The chief genera of this group now living are *Caryophyllia*, *Balanophyllia*, *Flabellum*, *Desmophyllum*, and *Sphenotrochus*, all simple forms; and *Lophohelia*, *Amphihelia*, *Dendrophyllia*, and *Astrangia*, compound forms.

The great majority of the reef-builders are compound forms, and those of Secondary, Tertiary, and Recent times belong to the families of the *Astræidæ*, *Poritidæ*, and *Madreporidæ*, though the *Oculinidæ* and *Fungidæ* also contribute to form reefs.

If coral-reefs existed in Palæozoic times, they were built up by Rugose corals. In Mesozoic times true reefs certainly existed at the close of the Trias, and especially in Oolitic times in Western Europe and England. In early Tertiary times vast

* From σκληρός, *hard*, and δερμα, δερματος, *skin*: applied to the corallum which is formed within the tissues of the sclerodermic corals.

reefs were formed in Central and Southern Europe, in Egypt, Syria, and Arabia, and in parts of India. (Nicholson.)

Gallery, No. 10.

Corals.

Wall-cases, Nos. 1 to 5, and Table-cases Nos. 1 to 8.

Three great divisions of the ZOANTHARIA-SCLERODERMATA are recognised, namely, the ZOANTHARIA-APOROSA, the ZOANTHARIA RUGOSA, and the ZOANTHARIA-PERFORATA.

The APOROSA are essentially a Secondary and Tertiary group. The RUGOSA are mainly confined to the Palæozoic period. The PERFORATA were largely represented in Palæozoic times, though certain families belong essentially to the Tertiary and Recent period.

The Actinozoa occupy Table-cases Nos. 1–9 and Wall-cases Nos. 1–6 along the western side of Gallery No. 10.

An interesting feature in the exhibited series of fossil corals consists in the introduction of a large series of transparent sections, mounted on glass and fixed at an inclination of about 45°, so as to give the observer a very good idea of the internal structure of the corallite in each genus.

A large number of the type specimens figured by MM. Edwards and Haime, W. Lonsdale, Prof. P. Martin Duncan, F.R.S., Prof. H. A. Nicholson, F.R.S.E., R. F. Tomes, F.G.S., R. Etheridge, F.R.S., R. Etheridge, junr., and A. H. Foord, are in the cases. Every figured specimen is indicated by a small green ticket.

A fine slab of polished marble known as "Frosterley stone," from the Carboniferous Limestone of Frosterley, near Stanhope, Durham, exhibits numerous sections of a Rugose coral called *Dibunophyllum.* This stone is used for the smaller columns supporting the arches in the chancel of Durham Cathedral and elsewhere. The specimen is placed in the recess between Wall-cases Nos. 3 and 4.

CLASS 20.—**Hydrozoa.**

This division embraces the HYDROIDA, or Hydroid Polypes; the HYDROCORALLINÆ (Millepores, &c.), and the GRAPTOLITHINÆ (Graptolites). Many members of this class are unknown as fossil forms, having no hard structures which could be preserved. In the Hydrozoa the walls of the digestive sac are not separated from those of the general body-cavity (as we have seen is the case in the ACTINOZOA), the two coinciding with one another. The generative elements are developed in medusoid forms, either free-swimming or attached permanently to the hydroid forms.

Under the HYDROIDA are placed the HYDRACTINIA from the Crag, in which deposit the calcareous skeleton is found encrusting shells; the globular forms of *Parkeria* from the Greensand

Gallery, No. 10.

Table-cases, Nos. 9, 10.

of England, and the genera *Syringosphæria* and *Stoliczkaria* from India.

In the HYDROCORALLINÆ are placed the Silurian genus *Labechia*, the Devonian and Silurian types of *Stromatopora*, and the Cretaceous and Tertiary *Millepora*.

Graptolites.

The last division of the HYDROZOA contains the GRAPTOLITHINÆ, a remarkable Palæozoic group characterised by the possession of a compound polypary with a tubular chitinous covering enclosing the cœnosarc, and supporting numerous cup-like "cellules" or *hydrothecæ*, in each of which a polypite was placed. The polypites were united to the cœnosarc. The polypary itself, which was apparently free and unattached, was strengthened by a chitinous rod or fibre termed the solid axis, no doubt similar to that observed in the polyzoön *Rhabdopleura*. The Graptolites present a great variety in their form and in the arrangement of the *hydrothecæ* on the axis, some having but a single row of closely-placed "cellules" or *hydrothecæ* on each branch (hence called "monoprionidian Graptolites"), others having a row of cellules on each side of the branch (hence called "diprionidian"). These forms of Graptolites (*diprionidian*) are, with hardly an exception, confined to the Ordovician series, whilst the *monoprionidian* forms range from the base of the Ordovician to the summit of the Silurian series.

With the exception of the genus *Dictyograptus*, which survived to the Devonian, the Graptolites are confined to the Cambrian, the Ordovician, and the Silurian.

The families, genera, and even the individual species, of *Graptolites* are, according to Prof. Lapworth, remarkably characteristic of special zones in the Silurian, and that apparently over extremely wide areas of the earth's surface.

Wall-case, No. 6. Table-case, No. 10.

The exhibited series of this interesting and important group of Palæozoic Hydrozoa is placed in Table-case No. 10 and Wall-case No. 6.

Sub-Kingdom.—PORIFERA.

CLASS 21.—**Spongida** (Sponges).

Sponges.

The Sponges form the lowest group of cœlenterate animals. With the exception of one small division, the *Myxospongiæ*, whose structure is entirely composed of soft, fleshy substance, sponges secrete hard skeletons, either of horny siliceous, or calcareous materials, and they have consequently been divided into *Ceratospongiæ*, *Silicispongiæ*, and *Calcispongiæ*. It is very doubtful if any of the Keratose, or horny sponges, similar to those in domestic use, have been preserved in the fossil state,

and thus only sponges with silicified or calcareous skeletons are found in the rocks. The Silicispongiæ are by far the most important of these two divisions: their skeletons consist of minute spicules of silica of various forms, in some cases united together into a beautiful meshwork, in others the spicules are loosely held in position in the sarcode, and after the death of the sponge they are scattered over the sea-bottom. In this way beds of rock are, in some instances, nearly entirely formed of the minute detached spicules of these sponges.

Gallery, No. 10.

Fossil Sponges.

Table-cases Nos. 11–15.

The Silicispongiæ are divided into four orders according to the form of their skeletal spicules:—(1) *Monactinellidæ*, in which the spicules have but a single axis; (2) *Tetractinellidæ*, in which the spicules have four rays or arms; (3) *Lithistidæ*, in which the spicules are four-rayed or irregular in form, and intimately interwoven together; and (4) *Hexactinellidæ*, in which the skeleton consists of spicules with six rays. As a rule, entire sponges of the two first-mentioned orders are rarely met with as fossils, though their detached spicules are very abundant, more particularly in the Upper Greensand and the Upper Chalk. The greater number of fossil sponges belong to the *Lithistidæ* and *Hexactinellidæ*.

Wall-cases, Nos. 7 and 8

With one or two exceptions fossil Calcisponges belong to the family of the *Pharetrones*. The spicules are mostly three or four-rayed, and they are united into a continuous fibrous network.

Fossil sponges are first met with in Cambrian strata, the earliest known genus, *Protospongia*, belongs to the Hexactinellidæ. In the Silurian rocks the Lithistidæ are represented by *Astylospongia* and *Aulocopium*; and the peculiar families of the *Receptaculitidæ* and the *Astræospongidæ* occur here and in the Devonian. Hexactinellid sponges, allied to the recent *Hyalonema*, were numerous in Carboniferous strata, and are principally represented by detached spicules and by bands of elongated spicules, which served to anchor the sponges in the mud.

With the exception of a small group of Calcisponges from the Triassic strata of St. Cassian, and from the Inferior Oolite of this country, fossil sponges are rarely met with until reaching the middle and upper Jura of Germany and Switzerland, in which the Lithistidæ and Hexactinellidæ are very abundant. Calcisponges are numerous in the Lower Greensand of Faringdon, Berkshire; and in the Upper Greensand of the South of England, Lithistid sponges are largely developed, as well as spicules of Tetractinellidæ and Monactinellidæ. Hexactinellid sponges distinguish certain zones of the gray Chalk and the Chalk Marl, and in the Upper Chalk representatives of all the groups of siliceous sponges are present. It is probable that the silica of the flints in the Upper Chalk is derived from the

Gallery, No. 10. Fossil Sponges.

skeletons of siliceous sponges; in many instances the flints are formed round the sponges, and when broken and their inner surfaces polished, the canals of the sponges are distinctly shown.

Sponges of Tertiary age are rare, and are represented by the minute borings of the genus *Cliona* in molluscan shells.

The Fossil Sponges occupy Table-cases Nos. 11–15, and Wall-cases Nos. 7 and 8.

Table-cases, Nos. 11 to 15, and Wall-cases, 7 & 8.

The Fossil Sponges have been most carefully described, catalogued, and copiously illustrated by Dr. G. J. Hinde, F.G.S., and the work has been published by order of the Trustees.

Sub-Kingdom 5.—Protozoa (First Life).

The animals placed in this division are extremely simple; they are generally of very minute size, and composed of an apparently structureless or but slightly differentiated jelly-like albuminoid substance, known as "sarcode"; they have no definite parts or segments, no distinct body-cavity, or nervous system, nor any definite alimentary apparatus.

They comprise all the simplest living organisms, such as the Infusorial Animalcules, the *Amœba*, *Foraminifera*, *Radiolaria*, &c.

The two last-named types have hard skeletons, and are consequently found as fossils.

Class 22.—**Radiolaria.**

The Radiolaria possess a siliceous skeleton, the parts of which are arranged in a more or less radiate manner. The soft sarcode, of which the animal's body is composed, forms a central mass, surrounded by a membranous capsule and an outer layer containing cell-like bodies, from which extend long filamentous ray-like threads of sarcode known as "pseudopodia."

The order includes *Polycystina*, *Acanthometrina*, *Thalassicollida*, and *Actinophryina*.

The Polycystina have been found on nearly every ocean floor both in high and low latitudes.

Their siliceous skeletons (of extreme microscopic minuteness) have accumulated until they have formed deposits of considerable thickness during the later geological epochs, and myriads of these exquisite microscopic forms may be obtained from many strata in Sicily; Greece; Oran, in Africa; Bermuda; Richmond, Virginia; and Barbadoes. Beds of rock composed of these organisms are now known even as far back in time as the Ordovician series.

CLASS 23.—**Foraminifera.**

Foraminifera. **Gallery, No. 10. Wall-case, No. 9, and Table-case, No. 16.**

The FORAMINIFERA* have the body protected by a shell or test, composed of carbonate of lime, or it may consist of particles of sand cemented together, whilst others have a horny or chitinous covering.

The body may be simple or may repeat itself indefinitely by budding. The sarcode composing the animal's body gives out long thread-like pseudopodia, which often unite to form a continuous layer of sarcode outside the shell. The pseudopodia reach the exterior either by perforations in the walls of the shell or simply by an opening in the last chamber.

The Foraminifera are generally divided into two great primary divisions, namely, the PERFORATA and the IMPERFORATA.

In the former the shell is perforated by more or less numerous pseudopodial foramina. In the latter the shell is *not* perforated, and may be arenaceous or "porcellanous."

The IMPERFORATA include the *Miliolida* forms, which range from the Trias to the recent seas, and the *Lituolida*, which commence in the Carboniferous period. About 17 genera are represented."

Globigerina. The PERFORATA include five families: the *Globigerinida*, so abundant in the Atlantic ooze, and also in the English Chalk, as to have led some writers to speculate on the Chalk-formation being identical with the modern deep-sea ooze in its mode of origin. The *Textulariidæ*, the *Rotalidæ*, and *Lagenidæ*, dating back to the Carboniferous and represented by many genera.

Fusulina. Lastly, the great group of the NUMMULITIDÆ, which in Carboniferous times built up vast masses of limestone in Russia, Central Europe, Armenia, India, China, Japan, and the United States, almost composed of *Fusulina*: and the *Nummulites*, which in Tertiary times played so conspicuous a part in building up the solid framework of the earth's crust, whether in Europe, Asia, or Africa. **Nummulites.**

The great Nummulitic Limestone often attains many thousands of feet in thickness, and extends from the Alps to the Carpathians, and is in full force in North Africa, both in Morocco and Algeria. In Egypt it was largely quarried during the early dynasties for the building of the Pyramids.

It occurs also in Asia Minor and Persia; thence it stretches to India, and from the passes of Cabul to Eastern Bengal and the frontiers of China.

With this family is also included the much-disputed *Eozoön*, met with in the Lower Laurentian Limestones of Canada.

* The FORAMINIFERA have been Catalogued by Professor T. Rupert Jones, F.R.S., and published by order of the Trustees.

Foraminifera. Wall-case, No. 9.

In Wall-case No. 9 is placed a series of models prepared by M. Alcide d'Orbigny, illustrative of the various forms of Foraminifera; also a set prepared by Drs. Reuss and Fritsch to illustrate Reuss's classification of this group.

Table-case, No. 16.

The British series of Foraminifera are arranged in Table-case No. 16 and the Foreign series in Wall-case No. 9.

PLANTÆ.

Plantæ. Gallery, No. 10. Wall-cases, Nos. 10 to 18. Table-cases, Nos. 17 to 32.

This group occupies the whole Eastern side of Gallery No. 10. The British specimens are arranged in Table-cases Nos. 17–32. The Foreign ones on the sloping shelf of Wall-cases Nos. 10–18; the larger specimens, both British and Foreign, are arranged on the horizontal shelves of the Wall-cases. The Plant series commences at the North end with the Post-Tertiary and Tertiary specimens; among the former may be mentioned the fine masses of *Chara* incrusted with carbonate of lime from Northamptonshire, and some very finely preserved leaves in tufa, or travertin, from Weimar; whilst among the Tertiary are many beautiful examples of leaves from the Bagshot beds of Bournemouth and Alum Bay. Among these is a palm-leaf more than a yard in length, referred to the genus Iriàrtea. There is an interesting series of fruits and seeds from the London Clay of Sheppey, collected and described by the late Dr. Bowerbank. The Eocene beds of Ardtun, in Mull, are represented by numerous slabs and specimens of leaves both of Plane-trees and Ferns, in fine preservation (*see* slab in glazed case between Wall-cases Nos. 11 and 12, containing leaves of *Platanus aceroides*.

The Miocene flora of Greenland is well represented by many fine specimens collected by Mr. Edw. Whymper, and described by the late Prof. O. Heer; and attention is also directed to the extensive series of Miocene and Eocene plant remains from Continental localities (chiefly in Austria), collected and named by Baron von Ettingshausen. The Cretaceous plants are illustrated by many interesting forms, such as the peculiar *Chondrites* from the Upper Greensand beds of Bignor, Sussex; the collection is also rich in Clathrarian stems, many of which have been collected and described by Mantell.

A fine series of Ferns, Conifers, and Cycads, from the Wealden of Hastings, has lately been acquired from the collector, Mr. P. Rufford. It contains many new forms and some fine examples of the Cycadaceous leaves and fruit of *Zamia* (*William-*

sonia), very similar to the species common to the Yorkshire Oolites. Among the Jurassic plants are many fine examples of stems of Cycads (*Mantellia*) from the Purbeck beds of Portland. **Gallery, No. 10. Plantæ.**

Two fine trunks of coniferous trees (Cedroxylon) are placed in the centre of the Gallery; one of these, formerly in the Baber Collection, has been cut transversely to show the structure. They are highly siliceous, and occur in the Purbeck Beds of the Isle of Portland. Another, but more slender, silicified tree from Portland, about 8 feet in height, is placed upon a pedestal between Wall-cases Nos. 12 and 13, on the East side of this Gallery.

The series of *Zamia* (*Williamsonia*) from the Scarborough Oolites is altogether unique. Some large stems of coniferous trees (*Araucarites*), from the Lower Lias of Lyme Regis, are mounted separately in frames and placed in the recesses between Wall-cases Nos. 13 and 14; 14 and 15.

The Triassic series is well represented by some large slabs from India containing well-preserved leaves of Ferns, the chief of which is known as *Glossopteris;* the collection has numerous specimens of this fern from South Africa and Australia. The Palæozoic plants are of much interest, the specimens having all been catalogued by Mr. R. Kidston. Among Permian forms may be mentioned the fine series of polished sections of silicified Fern-stems mostly belonging to the genus *Psaronius*, all showing a most perfect internal structure; they abound in the New Red Sandstone of the neighbourhood of Chemnitz, in Saxony, and have been described by M. Cotta. There is also a fine section of silicified stem of Tree-fern (Stemmatopteris) from Brazil. The Carboniferous plants are abundantly represented, not only from this country, but from all parts of the world. Among the Ferns are fine specimens of *Neuropteris*, *Sphenopteris*, *Pecopteris*, etc., many of them showing the sori, or fructification. The genera *Calamites*, *Lepidodendron*, *Lepidostrobus*, *Lepidophloios*, *Sigillaria*, and *Stigmaria*, etc., are all well represented in the collection. Under the Cycads are placed *Cordaites*, *Cardiocarpus*, etc. A peculiar genus of supposed plant is the *Palæoxyris* from the coal ironstones of Dudley. A stem section of a large coniferous tree (*Araucaryoxylon*) from the Calciferous Sandstone of Craigleith, near Edinburgh, occupies the recess between Wall-cases Nos. 16 and 17; the intimate structure of this is readily seen in microscopic sections exhibited in Table-case No. 31. Among Devonian plants are fine examples of the Irish fern, *Palæopteris*, from Kiltorkan, near Waterford, and the stems of *Psilophyton* from Canada and Scotland are somewhat numerous in the collection. Silurian plants are rare, and usually only imperfectly preserved, consisting chiefly of Algæ (*Bythotrephis*), and some other very uncertain forms, such as *Pachytheca*, etc.

Glazed-cases, b, c, and e, and Stands d, and dd.

A fine opalized tree *Spondylostrobus* from Tasmania, a series of *Cedroxylon* silicified woods from various localities, a large trunk of a tree from Purbeck Beds, Isle of Portland, and several Sigillaria stems from the Coal Measures are placed down the centre of this Gallery.

HISTORICAL AND TYPE COLLECTIONS, STRATIGRAPHICAL SERIES, ETC.

Gallery, No. 11.

Historical Collections.

Gallery No. 11. In this Gallery have been arranged, in seventeen cases, a series of nine Collections of historical and palæontological interest, bearing upon the early history of the British Museum and the study of Geology and Palæontology in this Country.

Sir Hans Sloane's Collection, 1753.

Table-case No. 16.

Taking the exhibition cases in *chronological order*, the earliest is the "Sloane Collection." This is the most ancient portion of the Geological Collection, having formed a part of the Museum of Sir Hans Sloane, Bart., F.R.S., acquired by purchase for the Nation in 1753.

The geological specimens are stated to have consisted "in what by way of distinction are called *extraneous fossils*, comprehending petrified bodies, as Trees, or parts of them; Herbaceous plants (the Botanical and Zoological specimens are now preserved in their respective Departments), Animal substances," &c.; and reported to be "the most extensive and most curious that ever was seen of its kind." Until 1857 the Fossils and Minerals formed one collection, so that a large part of the "Sloane Collection" consisted probably of mineral bodies and *not organic*, but in any case only about 100 specimens of invertebrate fossils can now be identified with certainty as forming part of the original Sloane Museum. Each specimen in the Sloane Collection had originally a number attached to it, corresponding to a carefully prepared Manuscript Catalogue, still preserved, which contains many curious entries concerning the various objects in the Museum. In the course of more than 130 years, many of these numbers have been detached from the objects or obliterated by cleaning. But as all fossils at this early date were looked upon *merely as curiosities*, but little attention was paid to the formation or locality whence they were derived. Historically, the collection has immense interest to us, marking the rapid strides which the science of Geology has made of late years, especially as regards its more careful and systematic methods of study.

Brander Collection, 1766.

The next Collection in chronological order is the "Brander Collection," and is the earliest one in which types of named and described species have been preserved.

Brander Collection, 1766.

Table-case, No. 16.

This Collection was formed by Gustavus Brander, F.R.S., F.S.A., in the earlier half of the last century, and an account of the same, with eight quarto plates, was published in 1766, entitled, "Fossilia Hantoniensia Collecta, et in Musæo Britannico deposita." The descriptions of the species given in the work were written by Dr. Solander, one of the officers of the British Museum. They were "collected in the County of Hampshire, out of the cliffs by the sea coast between Christchurch and Lymington, but more especially about the cliffs by the village of Hordwell, nearly midway betwixt the two former places" (*op. cit.*, p. 111).

Only a small number out of the original 120 figured specimens are now capable of being identified, the rest having become, in the course of 122 years, commingled with the far more numerous and later Eocene-Tertiary acquisitions, and so have lost their connection with this admirable Memoir. The engravings of the shells are equal to any modern published work descriptive of the fossils of the Eocene formation; but the names given by Dr. Solander are in many instances incorrect, according to our present knowledge of the genera of Mollusca.

Dr. William Smith's Collection, 1816-18.

Centre-case, East Wall.

The next series to which attention is directed, is the Collection of William Smith, LL.D. This was commenced about the year 1787, and purchased by the Trustees in 1816, a supplemental Collection being added by Dr. Smith in 1818.

It is remarkable as the first attempt made to identify the various strata forming the solid crust of England and Wales by means of their fossil remains. There had been other and earlier Collections of fossils, but to William Smith is due the credit of being the first to show that each bed of Chalk or Sandstone, Limestone or Clay, is marked by its own special organisms and that these can be relied upon as characteristic of such stratum, wherever it is met with, over very wide areas of country.

The fossils contained in this Cabinet were gathered together by William Smith in his journeys over all parts of England during thirty years, whilst occupied in his business as a Land Surveyor and Engineer, and were used to illustrate his works, "Strata Identified by Organized Fossils," with coloured plates quarto (1816; four parts only published); and his "Stratigraphical System of Organized Fossils" (quarto, 1817).

William Smith's Map, 1815.

A coloured copy of his large Map, the first Geological Map of England and Wales, with a part of Scotland, commenced in 1812 and published in 1815—size 8 feet 9 inches by 6 feet 2 inches, engraved by John Cary—is exhibited on the right hand side of this Gallery, near the entrance. It is well worthy of careful inspection.

William Smith was born at Churchill, a village of Oxfordshire, in 1769; he was the son of a small farmer and mechanic, but his father died when he was only eight years old, leaving

Gallery, No. 11. William Smith.

him to the care of his uncle, who acted as his guardian. William's uncle did not approve of the boy's habit of collecting stones ("pundibs" = *Terebratulæ*, and "quoit-stones" = *Clypeus sinuatus*); but seeing that his nephew was studious, he gave him a little money to buy books. By means of these he taught himself the rudiments of geometry and land-surveying, and at the age of eighteen he obtained employment as a land surveyor in Oxfordshire, Gloucestershire, and other parts, and had already begun carefully and systematically to collect fossils and to observe the structure of the rocks. In 1793 he was appointed to survey the course of the intended Somersetshire Coal-Canal, near Bath. For six years he was the resident engineer of the canal, and, applying his previously-acquired knowledge, he was enabled to prove that the strata from the New Red Marl (Trias) upwards, followed each other in a regular and orderly succession, each bed being marked by its own characteristic fossils, and having a general tendency or "dip" to the south-east.

To verify his theory he travelled in subsequent years over the greater part of England and Wales, and made careful observations of the geological succession of the rocks, proving also, by the fossils obtained, the identity of the strata over very wide areas along their outcrops.

His knowledge of fossils advanced even further, for he discovered that those *in situ* retained their sharpness, whereas the same specimens derived from the drifts or gravel-deposits were usually rounded and water-worn, and had reached their present site by subsequent erosion of the parent-rock.

In 1799 William Smith circulated in MS. the order of succession of the strata and imbedded organic remains found in the vicinity of Bath.

His Geological Map of England and Wales is dated 1815.

On June 1, 1816, he published his "Strata identified by Organised Fossils," with illustrations of the most characteristic specimens in each stratum (4to).

In 1817 he printed "A Stratigraphical System of Organized Fossils," compiled from the original geological collection deposited in the British Museum (4to).

In 1819 he published a reduction of his great Geological Map, together with several sections across England.

These have just been presented to the Museum by Wm. Topley, Esq., F.R.S., F.G.S., and are exhibited upon the wall near Smith's bust.

Mr. Smith received the award of the *first* Wollaston Medal and fund in 1831, from the hands of Prof. Sedgwick, the President of the Geological Society—"As a great original discoverer in English geology, and especially for his having

been the first, in this country, to discover and teach the identification of strata, and to determine their succession by means of their imbedded fossils."

Gallery, No. 11. William Smith.

In June, 1832, the Government of H.M. King William the Fourth awarded Mr. Smith a pension of £100 a year, but he only enjoyed it for seven years, as he died 28 Aug. 1839.

In 1835 the degree of LL.D. was conferred upon Mr. Smith by the Provost and Fellows of Trinity College, Dublin; but perhaps the highest compliment paid him was that by Sedgwick, who rightly named him "the Father of English Geology."

The bust above the case which contains William Smith's collection is a copy of that by Chantry surmounting the tablet to his memory in the beautiful antique church of All Saints, at Northampton, where his remains lie buried.

Sowerby's Mineral Conchology, 1812-45.

We come next to a collection, the very name of which betrays the antiquity of its origin. It is known as "Sowerby's Mineral Conchology."

Table-cases, Nos. 10, 11, 12, and Wall-case, No. 5.

This collection was begun by Mr. James Sowerby, prior to 1812, and continued by his son, Mr. James de Carle Sowerby, F.L.S., during the preparation of their great work entitled, "The Mineral Conchology of Great Britain," which appeared in parts, between June, 1812, and December, 1845, and forms a work of six volumes octavo, illustrated with 648 plates.

The value of this work consists in the fidelity and accuracy of the figures given, and also that most of the specimens drawn were here named and described for the first time. They comprise fossils from all parts of England and from every Geological formation.

The small green labels mark the specimens actually figured in the work. The Collection was purchased by the Trustees of the British Museum from Mr. J. de Carle Sowerby, January, 1861.

It may be interesting to record that many of the latter parts were illustrated by plates drawn by the late Mr. J. W. Salter, A.L.S., F.G.S., for so many years palæontologist to the Geological Survey. When a youth, Salter was apprenticed to Mr. J. de Carle Sowerby, F.L.S., who was at that time both a naturalist and an engraver. The youthful apprentice afterwards married his master's daughter, and became, as is well known, one of the most brilliant palæontologists in this country.

König's Icones, 1825.

Another curious but small series represents the "types" or "figured specimens" of "König's *Icones Fossilium Sectiles.*"

Table-case, No. 16.

This illustrated work, on miscellaneous fossils in the British Museum, was prepared by Mr. Charles König, the first Keeper of the Mineralogical and Geological Department, after its separation from the General Natural History Collections in 1825.

The engravings are rough, but characteristic, and the first "Century" (or 100 figures of fossils), is accompanied by descrip-

Gallery, No. 11.

tions; the plates of the second "Century" have names only, but no descriptions are published with them.

Gilbertson Collection, 1836.

A far more important Collection is that known as "The Gilbertson Collection."

Table-cases, Nos. 15 and 16.

In 1836 Prof. John Phillips published Vol. II. of his "Illustrations of the Geology of Yorkshire," which is devoted to the "Mountain Limestone District." In the Introduction, he writes as follows:—"My greatest obligation is to Mr. Wm. Gilbertson of Preston, a naturalist of high acquirements, who has for many years explored with exceeding diligence a region of Mountain Limestone, remarkably rich in organic remains. The collection which he has amassed from the small district of Bolland is at this moment unrivalled, and he has done for me, without solicitation, what is seldom granted to the most urgent entreaty; he has sent me for deliberate examination, at convenient intervals, the whole of his magnificent collection, accompanied by remarks dictated by long experience and a sound judgment." He (Gilbertson) had proposed to publish on the *Crinoidea* himself, but his sketches, as well as his specimens, were all placed at Prof. Phillips' disposal. Phillips adds —"An attentive examination of this rich collection rendered it unnecessary to study minutely the less extensive series preserved in other cabinets . . . . *most of the figures of fossils are taken from specimens* in Mr. Gilbertson's Collection, because these were generally the best that could be found."

The Gilbertson Collection was purchased for the British Museum in 1841.

The collections which follow mark a distinct era in the annals of Geological Science.

The London Clay Club, 1838.

Some fifty years ago a little Society was founded by a few London geologists, namely—Dr. J. Scott Bowerbank, F.R.S., Searles V. Wood, F.G.S., Prof. John Morris, F.G.S., Alfred White, F.L.S., Nathaniel T. Wetherell, F.G.S., James de Carle Sowerby, F.L.S., and Frederick E. Edwards, F.G.S., for the purpose of illustrating the Eocene Mollusca, and entitled the "London Clay Club."

Palæontographical Society, founded 1847.

They met at stated periods at each other's houses, and after a time they said, "Why should we not illustrate all the fossils of the British Islands, and from every formation?" No sooner proposed than a Society was founded, named the Palæontographical Society, in the year 1847, just forty-three years ago. The first volume, issued in that year, was "The Crag Mollusca," Part I., Univalves by Mr. Searles V. Wood, F.G.S. (with 21 plates).

Searles V. Wood's Crag Mollusca, 1826-1856.

Here is preserved the actual "Searles Wood Crag Collection." This collection was commenced in 1826, and occupied about 30 years in its formation. It represents the Molluscan fauna of the Red and Coralline Crags of the neighbourhood of

Woodbridge, and from Aldborough, Chillesford, Sudbourn, Orford, Butley, Sutton, Ramsholt, Felixstow, and many other localities in Suffolk, also from Walton-on-the-Naze, in Essex. The specimens so collected were employed by Mr. Searles Wood in the preparation of his "Monograph on the Crag Mollusca," published by the Palæontographical Society (1848–1861); with supplements in 1871, 1873, and 1879, illustrated by seventy-one quarto plates. Each figured specimen is indicated by a small green label affixed to it.

Table-cases Nos. 1, 2, and 3.

A geological description of the Crag formation by Mr. S. V. Wood, jun., F.G.S., and Mr. F. W. Harmer, was issued by the Palæontographical Society in 1871 and 1873.

The collection was presented by Mr. S. V. Wood to the British Museum, January, 1856, and a supplementary collection was given by Mrs. Searles V. Wood in 1885.

F. E. Edwards' Eocene Mollusca, 1835-1873.

Table-cases, Nos. 3, 4, 5, 6, 7, 8, 9.

The next "Palæontographical Collection" is of nearly equal antiquity and fully of equal merit. It is the Eocene Molluscan Collection formed by the late Frederick E. Edwards, Esq., F.G.S., about the year 1835, and was continually being added to, until a few years before his death, which happened in 1875. It was acquired for the Nation by purchase in 1873.

Originally intended to illustrate the fossils of the London Clay, Mr. Edwards extended his researches over the Eocene strata of Sussex, Hampshire, and the Isle of Wight, where, assisted by Mr. Henry Keeping, he made the most complete collection ever attempted by any geologist, and it still remains unrivalled.

Mr. Edwards contributed six Memoirs to the Palæontographical Society, 1848–1856; also separate papers to the "London Geological Magazine," 1846, the "Geologist," 1860, and the "Geological Magazine," 1865, descriptive of the Eocene Mollusca, in his collection.

Mr. S. V. Wood continued the work for Mr. Edwards, describing and figuring the "Eocene Bivalves" in the annual volumes of the Palæontographical Society for 1859, 1862, 1870, and 1877. Each specimen which has been figured is specially marked.

About 500 species have been described and figured, but the collection is very rich in new and undescribed forms.

The Collection of Davidson Brachiopoda, 1837-1886.

Table-cases, Nos. 13, 14, 15.

The last Collection is that of a Naturalist who devoted his entire life to the study and illustration of a single class of organisms, namely the Brachiopoda. It was formed by the late Thomas Davidson, Esq., LL.D., F.R.S., F.G.S., V.P. Pal. Soc., etc. (of West Brighton, and Muir-house, Midlothian), between the years 1837 and 1886, with the object of illustrating his great work on the "British Fossil Brachiopoda," published by the Palæontographical Society, in six quarto volumes, between the years 1850 and 1886, comprising 2290 pages of text,

Gallery, No. 11.

Davidson Collection, 1837-86.

and 234 plates, with 9,329 figures, and descriptions of 969 species; the plates having been drawn with his own hands.

Dr. Davidson was also the author of the Report on the Brachiopoda collected by H.M.S. "Challenger" (vol. 1, 1880); of the article "Brachiopoda," in the "Encyclopædia Britannica," Ninth Edition, 1875; of a Monograph of Recent "Brachiopoda" (Trans. Linnæan Society, 1886 and 1887), and of more than fifty other separate Memoirs mostly bearing upon Brachiopoda, both Recent and Fossil, printed in the Transactions and Journals of the various learned societies, etc.

His collection, both of Recent and Fossil Brachiopoda, together with all Dr. Davidson's original drawings, his numerous books and pamphlets, were bequeathed by him to the British Museum through his son William Davidson, Esq., February, 1886. By his direction the entire collection of recent and fossil species are to be kept together in one series for the convenience of reference for all men of science who may wish to consult the same.

Stratigraphical Collection.

The Stratigraphical Collection occupies Wall-cases, Nos. 1–4, along the western side of Gallery 11. A number of very fine specimens and slabs have been placed in these cases under their respective formations. The arrangement of these cases is still in progress.

Sowerby Collection. Cephalopoda.

Wall-case No. 5 contains the group Cephalopoda, figured and described in the "Mineral Conchology," by James and J. de C. Sowerby, and forms part of the Sowerby Collection (*see ante*, p. 95).

Rocks bored by Mollusca.

Wall-case, No. 6 (c).—This space is occupied by an interesting series of rocks from various localities and horizons, all of which have been bored by recent Molluscs such as *Pholas*, *Saxicava*, &c.

Tracks and Markings.

Wall-case No. 7 is entirely devoted to a large collection of *Tracks* and *Markings*, which may have been produced either by Molluscs, Annelids, Crustacea, &c., and others by the agency of rain or waves, and the atmosphere. Some of the finest examples are known under the names of *Harlania*, *Crossopodia*, *Arenicolites*, *Cruziana*, &c., and were formerly considered to be organic remains (such as Sponges, Plants, &c.).

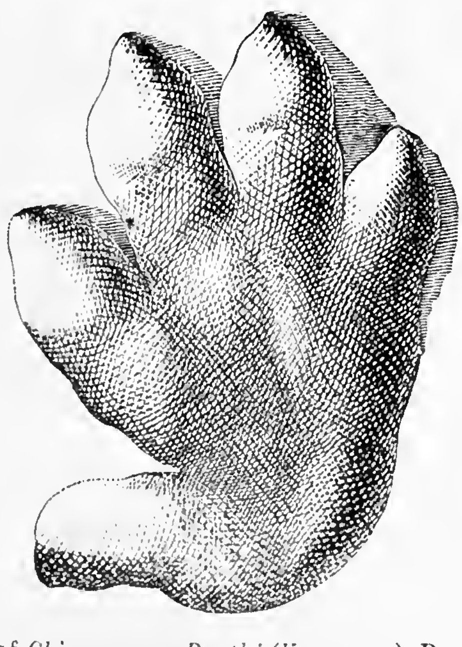
Footprints.

Wall-cases Nos. 8–10 are occupied by a fine series of Footprints and impressions mostly found in Sandstone of Triassic age. Attention is directed to the large slab from near Greenfield, Massachusetts, which is covered with impressions supposed to be the footmarks of birds or bipedal reptiles; these tracks are called "*Ichnites*."

The *Cheirotherium* footprints in Wall-case No. 10 are exceedingly fine; they occur chiefly in the Triassic Sandstones of Cheshire (*see* woodcut).

Gallery, No. 11. Footprints.

A



B

Fig. 94.—(A) Footprints of *Chirosaurus Barthi* (Kaup, sp.), Bunter sandstone, Hessberg, near Hildburghausen, Germany (reduced): (B) a single footprint (less reduced).

Saurian Collection.

Wall-cases, Nos. 11–13, contain a continuation of the Saurian Collection. No. 11 is devoted to the Genus *Plesiosaurus*, Nos. 12 and 13 to *Ichthyosaurus*. Many of these speci-

Gallery, No. 11.

mens having been figured and described by Hawkins, Sollas, and others. In Wall-case, No. 13, is a very complete and perfect specimen of *Ichthyosaurus tenuirostris* from the Lower Lias of Street, Somersetshire, presented by Alfred Gillett, Esq.

Paramoudras.

Two fine examples of "Pot Stones," or *Paramoudras*, are exhibited between Wall-cases, Nos. 1 and 2. These curious masses of Flint are from the Upper Chalk of Horstead, Norfolk, and were presented by John Gunn, Esq., F.G.S.

Specimens of Cores.

Between Wall-cases, Nos. 3 and 4, are placed two large cores of Carboniferous Limestone from the Spinney boring, Northampton; they were taken from a depth of 805 feet and 828 feet respectively from the surface, and were presented by J. Eunson, Esq., F.G.S.

Between Wall-cases, Nos. 4 and 5, is placed an example of Wenlock Shale from the trial-boring at Ware, Hertfordshire, at a depth of 825 feet from the surface, by the New River Water Company in attempting to procure water for London.

PART II.

EXPLANATION OF PLAN.

REPTILIAN GALLERIES Nos. 3, 4, 5, AND GALLERIES RUNNING NORTH, Nos. 6, 7, 8, 10, 11.

List of large objects placed on stands and in separate glazed cases, distinguished on the Plan by a special letter.

Gallery No. 3.

T. Very large head of *Ichthyosaurus* (much crushed), from the Lias of Lyme Regis.

U. Another nearly complete and well-preserved head of *Ichthyosaurus platyodon*, from the Lias of Lyme Regis. Presented by F. Seymour Haden, Esq.

V. Reproduction of a large head of *Ichthyosaurus*, the original preserved in the hall of the Geological Society, Burlington House.

W. Coloured reproduction of *Plesiosaurus Cramptoni*. The original is from the Lias (Alum Shale) of Whitby, Yorkshire; and is preserved in the Science and Art Museum, Dublin.

Gallery No. 4.

X. Coloured cast of skeleton of *Pelagosaurus typus*, with all the bones separate. The original from the Lias of Normandy.

Y. Nearly entire skeleton of *Scelidosaurus Harrisoni*, from the Lower Lias of Charmouth, Dorset.

y. Skeleton of *Hypsilophodon Foxii* from the Wealden, Brixton, Isle of Wight.

Z. Restored model of *Colossochelys atlas*, a gigantic land-tortoise, from the Siwalik Hills, India.

Z.Z. Skeleton of *Pariasaurus* from the Trias of South Africa.

a. Block of Limestone, from the "Roach Bed," Portland Oolite, Isle of Portland.

a.a. Slab of Petworth Marble composed of the shells of *Vivipara* (*Paludina*), *fluviorum*, Sussex.

b. Specimens of silicified and opalized woods, from various localities.

c. Opalized or silicified trunk of an extinct Coniferous Tree (*Spondylostrobus*). Discovered embedded in basaltic lava, probably of Pliocene age, on the estate of Richard Barker, Esq., Macquarie Plains, New Norfolk, Tasmania. Presented by the Tasmanian Commissioners for the 1851 Exhibition.

d. Two portions of the silicified trunks of Coniferous trees (Cedroxylon, Kaup), from the Purbeck Bed, top of the Portland Oolite, Isle of Portland.

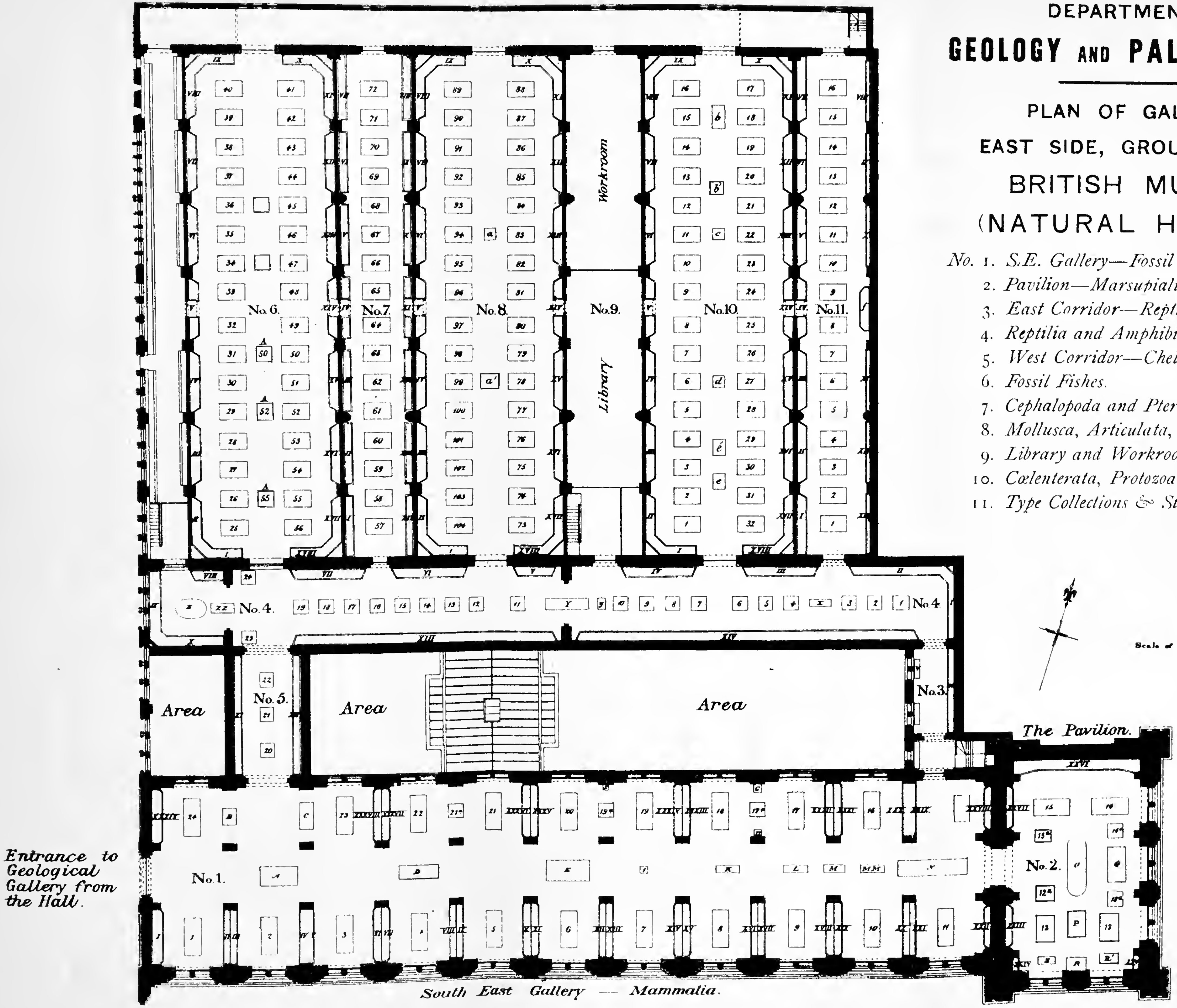
d.d. A second trunk of Cedroxylon from same locality.

e. Portions of the stems of Sigillaria and of a Lycopodiaceous Tree from the Coal Measures.

DEPARTMENT OF GEOLOGY AND PALÆONTOLOGY

PLAN OF GALLERIES EAST SIDE, GROUND FLOOR, BRITISH MUSEUM, (NATURAL HISTORY.)

No. 1. *S.E. Gallery—Fossil Mammalia.*
2. *Pavilion—Marsupialia,* ***Edentata****, Birds.*
3. *East Corridor—Reptilia.*
4. *Reptilia and Amphibia.*
5. *West Corridor—Chelonia and Amphibia.*
6. *Fossil Fishes.*
7. *Cephalopoda and Pteropoda.*
8. *Mollusca, Articulata, Echinodermata, etc.*
9. *Library and Workroom. (Private.)*
10. *Cœlenterata, Protozoa and Plants.*
11. *Type Collections & Stratigraphical Series.*



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BRITISH MUSEUM (NATURAL HISTORY)

CROMWELL ROAD, LONDON, S.W.

CATALOGUES.

Zoology.

Report on the Zoological Collections made in the Indo-Pacific Ocean during the voyage of H.M.S. 'Alert,' 1881–82. 1884, 8vo. £1 10*s*., pp. xxv., 684; 54 Plates.

Mammals.

Catalogue of Bones of Mammalia. 1862, 8vo. 5*s*.

——— Monkeys, Lemurs, and Fruit-Eating Bats. 1870, 8vo. 4*s*. Woodcuts.

——— Carnivorous Mammalia. 1869, 8vo. 6*s*. 6*d*. Woodcuts.

——— Seals and Whales. 2nd edition, 1866, 8vo. 8*s*. Woodcuts.

——— ——— Supplement, 1871, 8vo. 2*s*. 6*d*. Woodcuts.

List of the Specimens of Cetacea in the Zoological Department. 1885, 8vo. 1*s*. 6*d*.

Catalogue of Ruminant Mammalia (*Pecora*). 1872, 8vo. 3*s*. 6*d*.

——— Marsupialia and Monotremata. 1888, 8vo. £1 8*s*. Plates.

Birds.

Catalogue of Birds. Vols. III.–XIV. 1877–88, 8vo. 14*s*.–28*s*. Coloured Plates. [Vols. I. and II. out of print.]

Reptiles and Batrachians.

Catalogue of Chelonians, Rhynchocephalians, and Crocodiles. 1889, 8vo. 15*s.* Woodcuts and Plates.

Gigantic Land-Tortoises. 1877, 4to. £1 10*s.* Plates.

Catalogue of Lizards. 2nd edition, Vol. I. 1885, 8vo. 20*s.* Plates.

——————— Vol. II. 1885, 8vo. 20*s.* Plates.

——————— Vol. III. 1887, 8vo. 26*s.* Plates.

——— Colubrine Snakes. 1858, 12mo. 4*s.*

——— Batrachia Salientia. 1858, 8vo. 6*s.* Plates.

——— Batrachia Salientia. 2nd edition, 1882, 8vo. £1 10*s.* Plates.

——— Batrachia Gradientia. 2nd edition, 1882, 8vo. 9*s.* Plates.

Fishes.

Catalogue of Fishes, Vols. II.–VIII. 1861–70, 8vo. 7*s.*–10*s.* 6*d.* [Vol. I. out of print.]

Lepidopterous Insects.

Illustrations of Typical Specimens of Lepidoptera Heterocera. Parts I.–VII., 1877–89. 4to. 40*s.*–50*s.* Coloured Plates. [Pts. II. and IV. out of print.]

PALÆONTOLOGY.

Catalogue of Fossil Mammalia. Parts I.–V. 1885–87, 8vo. 4*s.*–6*s.* Woodcuts.

——— Fossil Reptilia and Amphibia. Parts I.–III.* 1888–89, 8vo., 7*s.* 6*d.* each. Woodcuts.

——— Fossil Fishes. Part I. 1889, 8vo. 21*s.* Woodcuts and Plates.

——— Fossil Cephalopoda. Part I. 1888, 8vo. 10*s.* 6*d.* Woodcuts.

——— British Fossil Crustacea. 1877. 8vo., 5*s.*

——— Blastoidea. 1886, 4to. 25*s.* Plates.

——— Fossil Sponges. 1883, 4to. 30*s.* Plates.

——— Fossil Foraminifera. 1882, 8vo. 5*s.*

——— Palæozoic Plants. 1886, 8vo. 5*s.*

The above catalogues can be obtained at the Natural History Museum, *Cromwell Road, South Kensington;* also through the agency of Messrs. LONGMANS & Co., 39, *Paternoster Row;* Mr. QUARITCH, 15, *Piccadilly;* Messrs. ASHER & Co., 13, *Bedford Street, Covent Garden;* and Messrs. TRÜBNER & Co., 57, *Ludgate Hill,* London.

* Part IV. will be ready for issue in May, 1890.

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BRITISH MUSEUM (NATURAL HISTORY).

DAYS AND HOURS OF ADMISSION.

The Exhibition Galleries are open to the Public, free, every day of the week, except Sunday, in

January,	from	10 A.M.	till	4 P.M.	
February,	,,	,,	,,	4.30 P.M.	
March,	,,	,,	,,	5.30	,,
April to August,	,,	,,	,,	6	,,
September,	,,	,,	,,	5.30	,,
October,	,,	,,	,,	5	,,
November and December,	,,	,,	,,	4	,,

Also from May 1st to the middle of July, on Mondays and Saturdays only, till 8 P.M.

And from the middle of July to August 31st, on Mondays and Saturdays only, till 7 P.M.

The Museum is closed on Good-Friday and Christmas-Day.

W. H. FLOWER,

Director.